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ABSTRACT

This curriculum guide was designed for use in postsecondary civil technology--surveying education programs in Georgia. Its purpose is to provide for development of entry level skills in surveying in the areas of knowledge, theoretical structure, tool usage, diagnostic ability, related supportive skills, and occupational survival skills. The first section of six explains the philosophies, purposes, and goals of vocational education in Georgia. Section 2 presents employability skills related to the occupational area of civil technology--surveying, specific occupational titles, student exit points, and tasks cross referenced to the Dictionary of Occupational Titles. Section 3, the largest part of the guide, provides unit guides for each task. (For each task, a task description, student performance objective, suggested instructional activities, instructional materials, evaluation section, and suggested instruction hours are included.) Section 4 contains the curriculum structure and course outline, while student record forms and competency certificates make up section 5. The last unit contains facility guidelines, with drawings, for group instruction and individualized instruction facilities. Appendixes to the guide contain references and resources, information on teaching special needs students, and definitions of terms. (KC)

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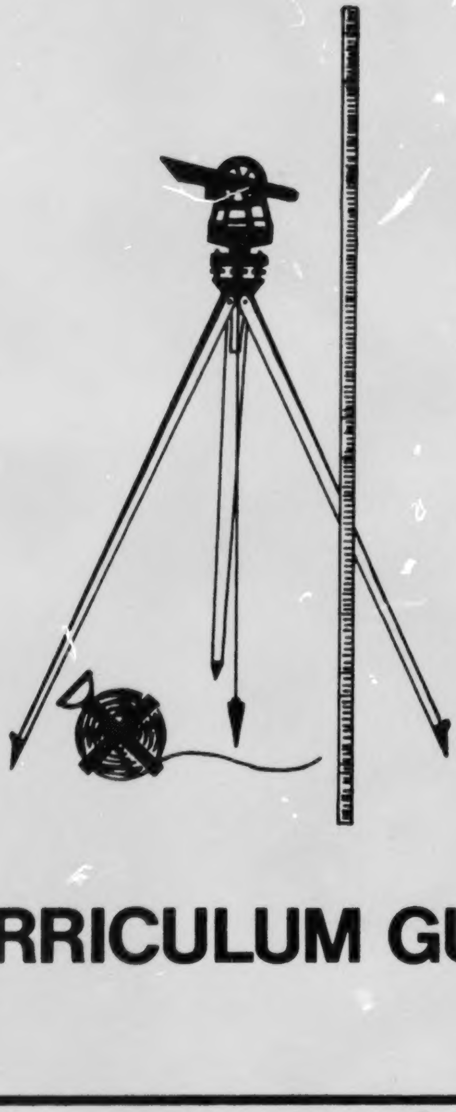
CIVIL TECHNOLOGY

SURVEYING
Post Secondary



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CURRICULUM GUIDE

Georgia Department of Education

CIVIL TECHNOLOGY - SURVEYING

Developed Under Contractual Agreement with

Division of Program Development
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Georgia Department of Education
Atlanta, Georgia 30334
Charles McDaniel, State Superintendent of Schools
1981

CIVIL TECHNOLOGY - SURVEYING

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POLICIES AND PROCEDURES FOR THE CENTER

PURPOSE OF THE CENTER

The Vocational Education Materials Center functions within the division of Vocational Education, University of Georgia. This Center operates under grants from the U.S. Office of Education, and the Georgia State Department of Education with the support of the College of Education. The Center is comprehensive in its commitment and approach to the development and dissemination of materials in the broad field of Vocational Education.

The purpose of the Center is to increase the capability of Georgia's delivery system for Vocational Education. Specifically, the Center is committed to:

1. Develop materials to assist in the implementation of proposed curricula and to enhance the teaching Vocational Education.
2. Conduct and report curriculum research related to Vocational Education.
3. Provide a production and dissemination center to Vocational Education materials.
4. Provide direct experiences in curriculum development and diffusion for advanced graduate stduents.
5. Enable faculty members to participate in the development and implementation of a variety of curriculum materials.

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PURPOSE AND UTILIZATION OF THE CURRICULUM GUIDES

The purpose of this curriculum guide is to provide a suggested model for organizing vocational instructional content. In many cases, more material is available than may be needed, there fore, an instructor will need to adapt the content to meet his/her program needs.

While the guide is primarily oriented towards the classroom, whether as a primary resource or as a supplement to other teaching materials; it may also assist administrators, counselors and lay people involved in local school systems. The following outline provides an overview of the various ways these groups may utilize the curriculum guides.

a) Vocational teachers.

1. Provide a guide for organizing their program of instruction,
2. Assist in establishing program objectives,
3. Serve as a curriculum materials resource guide,
4. Improve communications with employers and advisory committees
5. Facilitate competency based instruction,
6. Facilitate either group or self-paced instruction,
7. Include content by quarter and semester,
8. Cross-reference with existing state developed instructional materials (PLACE packages and post secondary I.I.).

b) Vocational supervisors and administrators.

1. Assist in defining the scope and content of their programs,
2. Provide a means to improve curriculum management functions,
3. Serve as a guide for admissions and job placement functions,
4. Improve communications with employers and advisory committees.

c) Counseling and guidance staff.

1. Provide a data base for counseling and guidance personnel,
2. Identify student exit points (Career Options),
3. Serve as guide for admissions and job placement,

4. Correlate with new State Board of Education graduation requirements,
5. Provide specific content sequencing by quarter and semester for student scheduling,
6. Provide (a) curriculum options for the disadvantaged handicapped student, (b) curriculum modifications for SPECIAL NEEDS students, (c) typical admission requirements for regular and SPECIAL NEEDS students.

(d) Local Curriculum Coordination Committees.

1. Serve as a guide in working out articulation arrangements,
2. Improve definitions of the relationship between secondary clusters and post secondary specialized programs.

Vocational teachers, supervisors and administrators, counseling and guidance staff and local curriculum coordination committees will be primary users of this guide, however, the use of the guide is not limited to these groups, but by any and all groups directly related in designing a vocational curriculum.

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-Foreword-

It has been the privilege of the Division of Vocational Education, University of Georgia, to participate in the development of 48 curriculum guides for Georgia vocational education programs. This work was sponsored by the Division of Program Development, Office of Vocational Education, State Department of Education. The completion of these guides meets a long standing need to provide a comprehensive curriculum overview of the vocational education programs available in Georgia schools. This developmental activity involved one of the largest professional staffs ever assembled for such work. Numerous teachers, teacher educators and state staff members have either written parts of the guides or served on the field review teams. These professionals were supported by a myriad of technical people and a host of typists who literally worked from dawn to dusk to ensure that the guides were produced in a timely fashion.

Be assured that this guide is not intended to be your curriculum or the curriculum of any school. The purpose of this project staff, and I am sure of the state OVE staff, is to offer a guide with supporting resources and teaching ideas from which the vocational instructor can extract a curriculum that meets local needs. The guide, however, does simplify curriculum decisions concerning sequencing and the selection of resources and media support.

The Task Linkage Project and appropriate V'TECS catalogs were used as the beginning point for this guide and all of the others. To assure that these task listings were directly related to Georgia vocational education programs and industry, they were subjected to additional study and review by appropriate teachers.

At some point in the future, this guide will need to be revised. To ensure that such a revision truly reflects the needs of Georgia's vocational education programs, the developers need your reactions, comments and ideas. We will also be interested in how you use this guide. Let us hear from you.

Paul Scott
Curriculum Guide Projects I & II

SECTION I

PHILOSOPHY, PURPOSE & OBJECTIVES

SECTION I

Section I Content List

State Philosophy and Goals
Local Philosophy and Goals

Section I provides an overview of the philosophies, purposes and goals for vocational education in the State of Georgia. These are applied to vocational education at the postsecondary level, however, it is recognized that more specific philosophies, purposes and goals will be applicable depending on the character of the local program.

VOCATIONAL EDUCATION IN GEORGIA

A. PHILOSOPHY

The Georgia Board of Education perceives vocational education as a vital component in the education of the young and adult citizens of this State. Appropriate programs of vocational education and ancillary services should be made readily available to individuals in middle schools, vocational divisions of junior colleges, vocational centers, the Quick Start program and other adult programs designed to train or retrain workers for useful and satisfying employment.

Special services and assistance must be provided to those who need it in order to participate or benefit from vocational education. This includes women, minorities, the displaced homemaker and other displaced workers, those with limited English-speaking ability, the disadvantaged and the handicapped.

Since men and women spend the greater part of their lives at some form of work, the State should provide opportunities for all its citizens to develop the knowledge, skills and attitudes necessary for them to secure personally satisfying and socially useful employment.

B. PURPOSE

The purpose of vocational education shall be to improve the economic well-being of Georgia citizens by preparing individuals, through organized learning experiences, to select, obtain and advance in recognized occupations.

POSTSECONDARY VOCATIONAL EDUCATION

A. PURPOSE

The purpose of postsecondary vocational-technical education in Georgia is to improve the economic well-being of adult citizens by providing access to high quality vocational-technical training for skilled and semi-skilled occupations, for improvement of existing skills or for retraining in a new occupation.

B. OBJECTIVES

1. To provide vocational-technical education programs and ancillary services commensurate with the needs and interests of students and available job opportunities.

2. To provide vocational-technical education programs which are current with the state-of-the-art, competency-based, and offer multiple exit points to accommodate the students' occupational objectives.

3. To provide vocational-technical education programs which are articulated with available high school counterparts, to facilitate an easy transition from secondary to postsecondary levels without loss of credit.

4. To provide vocational-technical education programs such that 75% of those individuals who leave or complete a program of occupational preparation will find employment in the field, or a related field, for which trained.

5. To provide those guidance, counseling, financial aid, evaluative, job placement, remedial and other supportive programs and services needed by students to enroll, complete a program and become, or remain, employable in a skilled or semi-skilled occupation.

6. To provide needed assistance to special populations to include women, minorities, limited English-speaking, the displaced homemaker and other displaced workers, the disadvantaged and the handicapped.

7. To provide vocational-technical education programs for full-time and part-time students on campus during the day as well as the evening hours, and to provide appropriate programs for full-time and part-time students off campus in businesses and industries, comprehensive high schools and other locations within the respective schools' service areas.

8. To serve as a center for the delivery of postsecondary and adult vocational-technical education programs and services for the community and assigned service area.

STATEMENT OF LOCAL SYSTEM PHILOSOPHY, PURPOSE AND OBJECTIVES FOR VOCATIONAL EDUCATION

(This page is intentionally left blank so that local systems may insert their copy of philosophy, purpose and goals for vocational education.)

SECTION II

PROGRAM DESCRIPTION & RELATED INFORMATION

SECTION II

Section II Content List

Employability Skills
Civil Technology - Surveying Occupational Description
Civil Technology - Surveying Program Objective
Definition of the D.O.T. Code
Description of Civil Technology - Surveying D.O.T.
Task Listing by D.O.T. Code

The major goal of vocational education in Georgia is to prepare individuals, through organized learning experiences, to select, obtain and advance in recognized occupations. Section II provides an overview of employability skills that are desirable in any occupation and relates their significance to the specific occupational area of Civil Technology - Surveying.

The Civil Technology - Surveying Program Objective contains the specific occupational titles. These occupational titles are further explained in the description of the occupational exit points and task listing. The concentration of the program is based on these tasks.

EMPLOYABILITY SKILLS

Employability skills exert a great deal of influence on a person's ability to get and keep a job. Surveys indicate that more people lose their jobs because of poor attitudes toward their job than for lack of job skills. For this reason it is important that information concerning the following employability skills be provided as an ongoing part of the program.

1. Getting a job
    a. Filling out job applications
    b. Developing a resume
    c. Preparing for a job interview

2. Keeping a job
    a. Be on time and regular in attendance
    b. Maintain a fair share of the work-load
    c. Work without supervision
    d. Meet production schedules
    e. Properly care for and use equipment
    f. Dress appropriately for the job
    g. Maintain good personal hygiene
    h. Develop and maintain good communication with supervisors and co-workers

A recent study sponsored by the Illinois Department of Adult, Vocational and Technical Education and conducted by the University of Illinois, "Survival Skills: Mastering the Human Aspects of Work", has identified twelve topics that might be developed into instructional modules for teaching occupational survival skills. The author, Robert E. Nelson, outlines these topics listed below and on the next page, each followed by a general objective which indicates the relationship between the topic and the survival skills required to maintain a job.

*"1. Working in an Organization: To familiarize students with the reasons for the formation of organizations and the common characteristics of organizations.
2. Understanding Self and Others: To have students develop insights into causes of human behavior and learn to interpret their own behavior and the behavior of other.

3. Motivation for Work: To have students develop and understanding of motivations into the work they perform.
4. Interpersonal Relations: To have students develop concepts and skills in interpersonal relations and apply them to work situations.
5. On-the-Job Communication: To have students understand the importance of effective communication and learn ways of communicating effectively on the job.
6. Using Creativity on the Job: To make students aware of their creative potential and to practice using their creative ability in hypothetical on-the-job situations.
7. Authority and Responsibility: To have students develop an understanding of the concepts of authority, power, influence, and responsibility as they apply to work situations.
8. Problem Solving: To have students develop skill in applying problem solving to their work.
9. Coping with Organizational Change: To make students aware of the process of organizational change and the techniques for coping with organizational change.
10. Coping with Organizational Conflict: To make students aware of the sources and types of conflicts encountered on the job and recognize ways of coping with conflicts in an organization.
11. Leadership: To have students recognize the need for leadership in work groups and increase their understanding of the leadership role in work situations.
12. Adapting and Planning for the Future: To have students develop perspectives of work in the future and the ability to plan for anticipated changes in their work roles."

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*Abstracted from the article, "Survival Skills: Mastering the Human Aspects of Work," by Robert E. Nelson, American Vocational Journal, November 1977.

SURVEYING AND SURVEYING TECHNICIANS*

Nature of Work

Surveyors with the assistance of surveying technicians establish official land boundaries, research deeds, write descriptions of land to satisfy legal requirements, assist in setting land valuations, measure construction and mineral sites and collect information for maps and cities.

Surveys are usually conducted by a survey party that determines the precise measurement of distances, directions and angles between points and of elevations, of points, lines and contours on the earth's surface. Land surveyors (D.O.T. 018.167-018), who may head one or more survey parties, are directly responsible for the party's activities and the accuracy of its work. They plan the fieldwork, select survey reference points and determine the precise location of natural and constructed features of the survey project area. They record the information disclosed by the survey, verify the accuracy of the survey data and prepare sketches, maps and reports.

A typical survey party is made up of the party chief (D.O.T. 018.167-010) and one of six assistants and helpers. The party chief leads the day-to-day work activities of the party. Surveyor assistants (D.O.T. 018.167-034) adjust and operate surveying instruments such as the theodolite (used to measure horizontal and vertical angles) and electronics equipment used to measure distances. These workers also compile notes, sketches and records of the data obtained from using these instruments. Surveyor helpers (D.O.T. 869.567-010) use a steel tape to measure distances between surveying points and use a level rod, a stadia rod, surveyor range pole or other equipment to aid assistants in determining elevations, distances and directions. Surveyor helpers also may clear brush and trees from the survey line and assist in setting survey markers.

Surveyors may specialize in a particular type of survey. Many perform land surveys to locate boundaries of a particular tract of land. They then prepare maps and legal descriptions for deeds, leases and other documents. Surveyors doing topographic surveys determine elevations, depressions and contours of an area and indicate the location of distinguishing surface features such as farms, buildings, forests, roads and rivers. Geodetic surveyors (D.O.T. 018.167-038) make precise, broad-area measurements which take into account the earth's curvature and its geophysical characteristics. Geophysical protecting surveyors (D.O.T. 018.167-042) mark sites for subsurface exploration, usually petroleum related. Marine surveyors (D.O.T. 018.167-046) survey harbors, rivers and other bodies of water to determine shorelines, topography of the bottom, depth and other features.

Several closely related occupations are geodesy and photogrammetry. Geodesists (D.O.T. 024.061-014) study the size, shape and gravitational field of the earth. They make the measurements and computations necessary for accurate mapping of the earth's surface. Photogrammetrists (D.O.T. 018.261-026) measure and interpret photographic images to determine the various physical characteristics of natural or constructed features of an area. By applying analytical processes and mathematical techniques to photographs obtained from aerial, space, ground and underwater locations, photogrammetrists are able to make detailed maps of areas that are inaccessible or difficult to survey by other methods. Control surveys on the ground are made to insure the accuracy of maps derived from photogrammatic techniques.

Working Conditions

Surveyors and surveying technicians usually work an 8-hour day, 5-day week. Sometimes they work longer hours during the summer months when weather conditions are most suitable for surveying.

The work of a survey party is active and sometimes strenuous. Party members often stand for long periods and walk long distances or climb hills with heavy packs of instruments and equipment. They also are exposed to all types of weather. Occasionally they must commute long distances or find temporary housing near the site.

Surveyors spend considerable time performing office duties, such as planning surveys, preparing reports and computations and drawing maps.

Places of Employment

About 62,000 persons worked as surveyors or surveying technicians in 1978. Federal, State and local government agencies employ about 1 out of every 10 of these workers. Among the Federal Government agencies are the U. S. Geological Survey, the Bureau of Land Management, the Army Corps of Engineers, the Forest Service, the National Ocean Survey, and the Defense Mapping Agency. Most surveyors and surveying technicians in State and local government agencies work for highway departments and urban planning and redevelopment agencies.

Nearly three-fourths of all surveyors and surveying technicians work for construction companies and for engineering and architectural consulting firms. A sizable number either work for or own firms that conduct surveys for a fee. Surveyors and surveying technicians also work for crude petroleum and natural gas companies and for public utilities.

Training, Other Qualifications, and Advancement

Most persons prepare for surveying work by combining postsecondary school courses in surveying with extensive on-the-job training. Some prepare by obtaining a college degree. Junior and community colleges, technical institutes and vocational schools offer 1-, 2-, and 3-year programs in surveying. A few 4-year colleges offer bachelor's degrees specifically in surveying, while many others offer several courses in the field.

High school students interested in pursuing a career in surveying should take courses in algebra, geometry, trigonometry, drafting and mechanical drawing.

High school graduates with no formal training in surveying usually start as surveyor helpers. After several years of on-the-job experience and some formal training in surveying, it is possible to advance to surveyor assistant, then to party chief and finally to licensed surveyor.

Beginners with postsecondary school training in surveying can generally start as surveyor assistants. After gaining experience, they usually advance to party chief and may later seek to become a licensed surveyor. In many instances, promotions to higher level positions are based on written examinations as well as experience.

For those interested in a career as a photogrammetrist, a bachelor's degree in engineering or the physical sciences is usually needed. Most photogrammetry technicians have had some specialized postsecondary school training.

All 50 States require licensing of land surveyors. Licensing requirements are generally quite strict, because once licensed, surveyors can be held legally responsible for their work. Requirements for licensure vary among the States. Generally, the quickest route to licensure is a combination of 4 years of college, 2 to 4 years of experience and passage of a State licensing exam. In most States, persons may qualify to take the licensing exam after 5 to 12 years of surveying experience. A few States now require a bachelor's degree, emphasizing surveying, as a prerequisite to licensure.

Surveyors and surveying technicians should have the ability to visualize and understand objects, distances, sizes, and other abstract forms. Also, because surveying mistakes can be very costly, surveyors must perform mathematical calculations quickly and accurately while paying close attention to the smallest detail. Leadership qualities also are important as surveyors must supervise the work of others.

Members of a survey party must be in good physical condition to work outdoors and carry equipment over difficult terrain. They also need good eyesight, coordination and hearing to communicate over great distances by hand or voice signals.

Employment Outlook

Employment of surveyors and surveying technicians is expected to grow about as fast as the average for all occupations through the 1980's. In addition to the openings resulting from employment growth, many will result from the need to replace those who die, retire or transfer to other fields or work.

The anticipated rapid growth in construction should create additional jobs for surveyors and surveying technicians to lay out streets, shopping centers, housing developments, factories, office buildings and recreational areas. In addition, as the value of land and thus the need for accurate surveys increase, more jobs will arise. Construction and improvement of the Nation's roads and highways also will create many new surveying positions. However, employment may fluctuate from year to year because construction activity is sensitive to changes in economic conditions.

*Occupational Outlook Handbook, 1980-81 ed.

CIVIL TECHNOLOGY - SURVEYING PROGRAM OBJECTIVE

Given appropriate instruction, as suggested by this guide, a student completing the program should demonstrate entry level skills in Civil Technology - Surveying in the areas of knowledge, theoretical stucture, tool usage, diagnostic ability, related supportive skills and occupational survival skills.

As the student progresses through the program, sufficient competencies will be acquired to enable the student to enter the occupational field at the following D.O.T. Codes.*

Surveyor Helper	(D.O.T. Code 869.567-010)
Civil Drafter	(D.O.T. Code 005.281-010)
Surveyor Assistant	(D.O.T. Code 018.167-034)

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*Dictionary of Occupational Titles, 1977 ed.

DEFINITION OF D.O.T. CODE*

As a result of technological, economic and sociological influences, nearly every job in the economy is performed slightly differently from any other job. Every job is also similar to a number of other jobs. In order to look at the millions of jobs in an organized way, job titles are designated a 9-digit occupational code. Each set of three digits in the D.O.T. Code has a specific purpose or meaning that differentiates it from all other codes.

The first three digits of the D.O.T. Code identify a particular occupational group. In the code 652.382-010, the first digit indicates an occupational category. The second digit refers to a division within the occupational category. The third digit defines a specific occupational group within a division.

The middle three digits of the D.O.T. Code 652.382-010 are the worker function rating of the tasks performed in the occupation. Every job requires a worker to function, to some degree, in relation to data, people and things. A separate digit expresses the worker's relationship to each of these three groups. Worker functions involving more complex responsibility and judgment are assigned lower numbers while functions which are less complicated have high numbers.

The last three digits of the D.O.T. Code 652.382-010 indicate the alphabetical order of titles within 6-digit code groups. They serve to differentiate a particular occupation from all others. A number of occupations may have the same first six digits, but no two D.O.T. Code can have the same nine digits.

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*Dictionary of Occupational Titles, 1977 ed.

DESCRIPTION OF OCCUPATIONAL EXIT POINTS*

869.567-010 SURVEYOR HELPER

Performs any of following duties to assist in surveying land: Holds level or stadia rod at designated points to assist in determining elevations and laying out stakes for mapmaking, construction, mining, land and other surveys. Calls out reading or writes station number and reading in notebook. Marks points of measurement with elevation, station number or other identifying mark. Measures distance between survey points, using steel or cloth tape or surveyor's chain. Marks measuring points with keel (marking crayon), paint sticks, scratches, tacks or stakes. Places stakes at designated points and drives them into ground at specified elevation, using hammer or hatchet. Cuts and clears brush and trees from line of survey, using brush hook, knife, ax or other cutting tools. May perform duties as directed by Land Surveyor or Surveyor Assistant, Instruments. May perform one operation and be designated accordingly as Brush Clearer, Surveying; Staker, Surveying; Surveyor Helper, Chain; Surveyor Helper, Rod.

005.281-010 DRAFTER, CIVIL

Drafts detailed construction drawings, topographical profiles and related maps and specification sheets used in planning and construction of highways, river and harbor improvements, flood control, drainage and other civil engineering projects, performing duties as described under Drafter. Plots maps and charts showing profiles and cross-sections, indicating relation of topographical contours and elevations to buildings, retaining walls, tunnels, overhead powerlines and other structures. Drafts detailed drawings of structures and installations such as roads, culverts, fresh water supply and sewage disposal systems, dikes, wharfs and breakwaters. Computes volume of tonnage of excavations and fills and prepares graphs and hauling diagrams used in earthmoving operations. May accompany survey crew in field to locate grading markers or to collect data required for revision of construction drawings. May be designated according to type of construction as Drafter, Reinforced Concrete; Drafter, Water and Sewage.

018.167-034 SURVEYOR ASSISTANT, INSTRUMENTS

Obtains data pertaining to angles, elevations, points and contours used for construction, mapmaking, mining or other purposes, using alidade, level, transit, planetable, theodolite, electronic distance measuring equipment and other surveying instruments. Compiles notes, sketches and records of data obtained and work performed. Directs work of subordinate members of survey team. Performs other duties relating to surveying work as directed by Chief of Party.

*Dictionary of Occupational Titles, 1977, ed.

TASK LISTING BY D.O.T. CODE

In this section the occupational exit points from the curriculum are cross referenced with the tasks which are required for employment in each job title. On the line following each task an x appears in the column of each job title to which to task applies. All the tasks listed in this matrix are taught in the curriculum presented in this guide. A detailed treatment of each task appears in the Unit Guides section of this curriculum guide.

TASK LISTING BY DOT CODE

CIVIL TECHNOLOGY - SURVEYING

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Surveyor Helper	Civil Drafter	Surveyor Assistant			
	DOT NO.	869.567-010	005.281-010	018.167-034			
Duty I:	Basic Surveying Procedures						
BSP-01	Understanding surveying careers	X	X	X			
BSP-02	Maintaining general survey notes	X	X	X			
BSP-03	Performing safely while surveying	X		X			
BSP-04	Pacing for distance measurement	X		X			
BSP-05	Determining direction with the hand compass	X		X			
BSP-06	Traversing by compass-pacing methods	X		X			
BSP-07	Using surveying hand signals	X		X			
BSP-08	Clearing line and bush	X		X			
BSP-09	Giving line	X		X			
BSP-10	Using targets for line	X		X			
BSP-11	Using the Philadelphia rod	X		X			
Duty II:	Measuring Distance						
MD-01	Performing rear chaining - horizontal	X		X			
MD-02	Performing head chaining - horizontal	X		X			

TASK LISTING BY DOT CODE

CIVIL TECHNOLOGY - SURVEYING

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Surveyor Helper	Civil Drafter	Surveyor Assistant			
	DOT NO.	869.567-010	005.281-010	018.167-034			
MD-03	Maintaining chaining notes - horizontal	X	X	X			
MD-04	Performing rear chaining - slope	X		X			
MD-05	Performing head chaining - slope	X		X			
MD-06	Maintaining chaining notes - slope	X	X	X			
Duty III:	Measuring Elevation						
ME-01	Understanding general leveling		X	X			
ME-02	Maintaining notes for level runs		X	X			
ME-03	Understanding leveling field procedures		X	X			
ME-04	Using the dumpy level			X			
Duty IV:	Measuring Angles						
				X			
MA-01	Using the standard one-minute transit			X			
MA-02	Using the standard 30-second transit			X			
MA-03	Using the standard 20-second transit			X			
MA-04	Using the theodolite			X			

TASK LISTING BY DOT CODE

CIVIL TECHNOLOGY - SURVEYING

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Surveyor Helper	Civil Drafter	Surveyor Assistant			
	DOT NO.	869.567-010	005.281-010	018.167-034			
Duty V:	Traversing						
TR-01	Traversing with the standard transit and chain			X			
TR-02	Maintaining notes for transit traverses		X	X			
TR-03	Setting points on line			X			
TR-04	Bucking in on line			X			
TR-05	Prolonging a line			X			
TR-06	Deflecting around an object			X			
Duty VI:	Surveying Mathematics						
SM-01	Understanding rounding and significant digits		X	X			
SM-02	Understanding surveying errors and precision		X	X			
SM-03	Performing angle computations		X	X			
SM-04	Computing traverse directions		X	X			
SM-05	Performing right triangle computations		X	X			
SM-06	Correcting distance measurements		X	X			

TASK LISTING BY DOT CODE

CIVIL TECHNOLOGY - SURVEYING

		POSSIBLE EXIT POINTS					
		DOT DESCRIPTIONS	Surveyor Helper	Civil Drafter	Surveyor Assistant		
TASK NO.	TASK NAME	DOT NO.	869.567-010	005.281-010	018.167-034		
SM-07	Computing latitudes and departures			X	X		
SM-08	Balancing a closed traverse			X	X		
SM-09	Computing area of a closed traverse			X	X		
SM-10	Computing coordinates of a traverse			X	X		
SM-11	Computing closed traverses			X	X		
SM-12	Inversing between coordinates			X	X		
SM-13	Computing distance-distance intersections			X	X		
SM-14	Computing distance-bearing intersections			X	X		
SM-15	Computing bearing-bearing intersections			X	X		
SM-16	Using a programmable calculator			X	X		
Duty VII: Basic Drafting Procedures							
BDP-01	Understanding drafting terminology and symbols			X			
BDP-02	Using drafting instruments			X			
BDP-03	Lettering on engineering drawings			X			
BDP-04	Performing linework			X			

TASK LISTING BY DOT CODE

CIVIL TECHNOLOGY - SURVEYING

		POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Surveyor Helper	Civil Drafter	Surveyor Assistant			
	DOT NO.	869.567-010	005.281-010	018.167-034			
TASK NO.	TASK NAME						
BDP-05	Using a civil engineering scale		X				
BDP-06	Recognizing drafting media		X				
BDP-07	Performing print duplication		X				
Duty VIII:	Route Drafting						
RD-01	Drafting preliminary profiles		X				
RD-02	Drafting preliminary cross sections		X				
RD-03	Drafting final construction drawings		X				
Duty IX:	Mapping						
MP-01	Plotting field data		X				
MP-02	Interpreting and plotting contours						
MP-03	Using topographic symbols and conven-		X				
	tions		X				
Duty X:	Platting						
			X				
PL-01	Drafting land plats		X				

TASK LISTING BY DOT CODE

CIVIL TECHNOLOGY - SURVEYING

	POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Surveyor Helper	Civil Drafter	Surveyor Assistant			
	DOT NO.	869.567-010	005.281-010	018.167-034			
TASK NO.	TASK NAME						
PL-02	Drafting subdivision plats		X				
Duty XI:	Boundary Surveys						
BS-01	Understanding boundary definitions and terminology			X			
BS-02	Understanding the historical prespective of land surveying			X			
BS-03	Understanding the legal basis of land surveying			X			
BS-04	Identifying evidence			X			
BS-05	Determining senior evidence			X			
BS-06	Conducting legal research - tax office			X			
BS-07	Conducting legal research - superior court record room			X			
BS-08	Conducting legal research - archives			X			
BS-09	Understanding field procedures for boundary surveys			X			
BS-10	Subdividing land			X			
BS-11	Writing legal descriptions			X			

TASK LISTING BY DOT CODE

CIVIL TECHNOLOGY - SURVEYING

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS: Surveyor Helper	Civil Drafter	Surveyor Assistant			
	DOT NO.	869.567-010	005.281-010	018.167-034			
Duty XII:	Route Surveys						
RS-01	Understanding route surveying definitions and terminology			X			
RS-02	Calculating horizontal curves			X			
RS-03	Calculating stakeout data of horizontal curves			X			
RS-04	Calculating vertical curves			X			
RS-05	Calculating stakeout data of vertical curves			X			
RS-06	Planning and designing route surveys			X			
RS-07	Computing earthwork quantities			X			
RS-08	Staking out horizontal curves			X			
RS-09	Staking out vertical curves			X			
RS-10	Staking out highway slopes			X			
Duty XIII:	Construction Surveys						
CS-01	Conducting a reconnaissance survey			X			
CS-02	Conducting a preliminary survey			X			

TASK LISTING BY DOT CODE

CIVIL TECHNOLOGY - SURVEYING

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS DOT NO.	Surveyor Helper 869.567-010	Civil Drafter 005.281-010	Surveyor Assistant 018.167-034			
CS-03	Conducting a location survey			X			
CS-04	Conducting a pipeline survey			X			
CS-05	Performing subdivision construction staking			X			
Duty XIV:	Topographic Surveys						
TS-01	Understanding topographic definitions and terminology			X			
TS-02	Using a plane table and alidade			X			
TS-03	Using stadia for distance and elevation			X			
TS-04	Field mapping using a grid system			X			
TS-05	Field mapping using controlling points			X			

SECTION III

UNIT GUIDES

SECTION III

Section III Content List

Unit Guide Description
Suggested Sequence of Unit Guides

In Section II, the relationship between the occupational area and program tasks was introduced. Section III continues this development by presenting, for each task, a unit guide for instructional planning and execution.

The instruction of specific tasks is central to vocational education. However, the value of a single task/competency to the student as a prospective member of the workforce is dependent upon the way in which that task/competency is related to other tasks and to the entire occupational area. Therefore, the Civil Technology - Surveying Program Task Listing provides a sample organizational model for sequencing the instruction of program tasks.

UNIT GUIDES DESCRIPTION

In this section the tasks to be taught in each course are presented in sequential order. Each task is listed on a separate page so that it may be taken out of the guide for daily lesson planning or regrouped with order tasks to fit the individual teacher's preference for teaching order. The task pages may be used for planning and executing group instruction or for individualized instruction. Each page in the UNIT GUIDES section contains the following information:

TASK: This is a short and concise statement of the task to be taught.

PERFORMANCE OBJECTIVE: The performance expected of the student after completing the unit is stated in stem form, without a specific statement of all conditions, equipment and performance standard (these are listed in a criterion referenced measure in the Evaluation section of the task page).

INSTRUCTIONAL ACTIVITIES: Suggested learning activities are presented. These activities include providing information, demonstration, practical applications and projects.

INSTRUCTIONAL MATERIALS: Suggested materials for carrying out the instructional activities are listed. These include textbooks and equipment. Textbooks are referenced by author and title with the complete reference contained in the textbook list in the Instructional Resources section.

EVALUATION: This section contains a criterion referenced measure and reference to any test items or other evaluation measures that are available to teacher.

CLASS/LAB HOURS: The estimated time for completion of the instructional activities and the evaluation are indicated in both classroom and lab hours. Total instructional time would be the sum of these.

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TASK

BSP-01 Understanding surveying careers

PERFORMANCE OBJECTIVE

Understand the careers available in the surveying field.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Surveying in general
b. Jobs in the surveying field
c. Types of surveying
d. Definitions and terminology

Provide Demonstration On:

Types of surveying

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Davis, Foote and Kelly, Survey: Theory and Practice
c. McCormac, Surveying
d. Pafford, Handbook of Survey Notekeeping

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS 0

CLASS HOURS 9

EVALUATION (BSP-01)

Given text assignments, resource materials and instructor lecture, the student will express an understanding of surveying career opportunities to the instructor's satisfaction.

TASK

BSP-02 Maintaining general surveying notes

PERFORMANCE OBJECTIVE

Maintain proper notekeeping on a field survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Civil lettering
b. Setting up a fieldbook
c. Rules for entering data
d. Rules for correcting mistakes
e. Legal implications of fieldbooks
f. Symbols used in notekeeping
g. Verbal process in proper notekeeping
h. Importance of area and location sketches

Provide Demonstration On:

a. Proper notekeeping techniques
b. Sample notekeeping formats for various surveys

Provide Practical Application On:

a. Location sketches
b. Sketches of "found" evidence
c. Simple field survey notekeeping
d. Interpreting field notes prepared by others

INSTRUCTIONAL MATERIALS

Textbooks:

a. McCormac, Surveying
b. Pafford, Handbook of Survey Notekeeping

Tools and Equipment:

a. Fieldbook
b. 4H pencil
c. Straight edge

LAB HOURS	6
CLASS HOURS	3

EVALUATION (BSP-02)

Using proper notekeeping techniques on an actual field survey, the student will maintain a complete set of fieldnotes. Fieldnotes will be submitted to the instructor and two advanced students - each of which will verify that the sketches and data are clear, correct and ready for reduction or computation.

TASK

BSP-03 Performing safely while surveying

PERFORMANCE OBJECTIVE

Perform basic first aid and exhibit safe field practices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Basic first aid
b. Poisonous snakes and insects
c. Poisonous plants
d. Proper clothing
e. Heat stroke and heat exhaustion - cause and treatment
f. Hypothermia - cause and treatment

Provide Demonstration On:

First aid

Provide Practical Application On:

First aid

INSTRUCTIONAL MATERIALS

Textbooks:

a. American Red Cross, Multi-Media Standard First Aid
b. American Red Cross, Standard First Aid and Personal Safety

Tools and Equipment:

a. First aid kit
b. Snake bite kit

LAB HOURS	0
CLASS HOURS	9

EVALUATION (BSP-03)

Given a written exam covering first aid and general safe practices in field surveying, the student will obtain a score of at least 90%.

TASK

BSP-04 Pacing for distance measurement

PERFORMANCE OBJECTIVE

Use pacing to measure distance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Determine length of pace
b. Notekeeping for pacing
c. Pacing over varying terrain
d. Calculating length of line after pacing

Provide Demonstration On:

a. Proper pacing
b. Determine length of pace
c. Notekeeping
d. Calculating distance

Provide Practical Application On:

a. Pacing between points:
    1. On level ground
    2. Up hill
    3. Down hill
    4. Varying terrain
b. Computing distance

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. 4H pencil
c. Straight edge

LAB HOURS	6
CLASS HOURS	3

EVALUATION (BSP-04)

Using proper pacing techniques, the student will determine the distance between points over varying terrain to an accuracy of one foot in fifty feet as compared to actual measured distance and properly record field information in fieldbook.

TASK

BSP-05 Determining direction with the hand compass

PERFORMANCE OBJECTIVE

Determine and give direction with a hand compass.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reading a compass
b. Magnetic delination
c. Local attraction
d. Types of compasses
e. Bearings
f. Azimuths
g. Notekeeping

Provide Demonstration On:

a. Use of compass to determine direction
b. Use of a compass to give direction
c. Effects of local attraction

Provide Practical Application On:

a. Using a compass
b. Identifying local attraction
c. Avoiding local attraction
d. Notekeeping

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. 4H pencil
c. Straight edge
d. Hand compass
e. Range pole

LAB HOURS	6
CLASS HOURS	3

EVALUATION (BSP-05)

Using proper techniques, the student will accurately determine the direction of a set of lines and record findings in fieldbook. The instructor will compare student's finding against actual directions.

TASK

BSP-06 Traversing by compass-pacing methods

PERFORMANCE OBJECTIVE

Complete a traverse using a hand compass and pacing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of traversing
b. Traverse notekeeping
c. Sources of error
d. Types of mistakes

Provide Demonstration On:

a. Proper notekeeping techniques
b. Review use of compass

Provide Practical Application On:

Various types of traverses

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. 4H pencil
c. Straight edge
d. Compass
e. Range pole

LAB HOURS	12
CLASS HOURS	6

EVALUATION (BSP-06)

Given a hand compass and using pacing, the student will accurately gather data and record the data in his/her fieldbook on a traverse. The calculated traverse closure must be accurate to one foot or less in fifty.

TASK

BSP-07 Using surveying hand signals

PERFORMANCE OBJECTIVE

Use hand signals to transfer information to other members of a survey crew.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

Types of signals for various types of surveys

Provide Demonstration On:

Proper hand signaling techniques

Provide Practical Application On:

Performing various hand signals

INSTRUCTIONAL MATERIALS

Textbooks:

a. McCormac, Surveying
b. Pafford, Handbook of Survey Notekeeping

LAB HOURS	6
CLASS HOURS	3

EVALUATION (BSP-07)

Given various information that must be transferred to others during a field survey, the student will perform the hand signal for each information item with 100% accuracy.

TASK

BSP-08 Clearing line and bush

PERFORMANCE OBJECTIVE

Clear brush and bushes from a survey line.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. General safety
b. Use of a bush axe
c. Use of a machete
d. Use of a chain saw
e. Sharpening and maintenance of cutting tools

Provide Demonstration On:

Safe use of:
a. Bush axe
b. Machete
c. Chain saw

Provide Practical Application On:

a. Using a machete
b. Using a bush axe
c. Using a chain saw
d. First aide for cuts

INSTRUCTIONAL MATERIALS

Textbooks:

Various tool manufacturer's maintenance manuals

Tools and Equipment:

a. Machete
b. Bush axe
c. Chain saw

LAB HOURS	18
CLASS HOURS	6

EVALUATION (BSP-08)

Under actual field conditions, the student will accurately demonstrate the proper and safe use of a machete, bush axe and chain saw.

TASK

BSP-09 Giving line

PERFORMANCE OBJECTIVE

Demonstrate proper use of a plumb bob and range pole to give line for a transit survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Using a plumb bob
b. Using a range pole

Provide Demonstration On:

a. Holding a plumb bob over a point
b. Holding a range pole plumb

Provide Practical Application On:

a. Plumbing a range pole
b. Holding a plumb bob over a point at various heights

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Range pole
b. Plumb bob (16 oz.)

LAB HOURS 18
CLASS HOURS 6

EVALUATION (BSP-09)

Given a plumb bob and range pole, the student will accurately demonstrate the proper use of a range pole and proper holding of a plumb bob at various heights.

TASK

BSP-10 Using targets for line

PERFORMANCE OBJECTIVE

Set up a traversing target over points on a field survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Various targets
b. Care of targets
c. Setting up targets

Provide Demonstration On:

a. Proper care of targets
b. Setting up targets over various types of terrain

Provide Practical Application On:

Setting up targets under various field conditions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Target
b. Tripod

LAB HOURS	18
CLASS HOURS	6

EVALUATION (BSP-10)

Under actual field conditions, the student will set up the target over a given point in a time not to exceed five minutes.

TASK

BSP-11 Using the Philadelphia rod

PERFORMANCE OBJECTIVE

Use the Philadelphia rod on field survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of rods
b. Turning points
c. Hand signals
d. Reading the rod
e. Use of a rod
f. Care of a rod

Provide Demonstration On:

a. Selecting turning points
b. Hand signals
c. Reading the rod
d. Using a rod

Provide Practical Application On:

a. Using a rod
b. Selecting turning points
c. Reading a rod

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, *Elementary Surveying*
b. McCormac, *Surveying*

Tools and Equipment:

Philadelphia rod

LAB HOURS 18
CLASS HOURS 6

EVALUATION (BSP-11)

a. Given a written exam on the use, care and reading of a rod, the student will score at least 70%.

b. Under actual field conditions, the student will accurately demonstrate the selection of turning points, proper use of hand signals and proper rod holding.

TASK

MD-01 Performing rear chaining-horizontal

PERFORMANCE OBJECTIVE

Perform rear chaining - horizontal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Horizontal chaining
b. Types of chains
c. Reading a chain
d. Care and use of a chain
e. Staying on line
f. Use of hand level to keep chain horizontal
g. Using a plumb bob
h. Using chaining pins

Provide Demonstration On:

a. Care and use of a chain
b. Using hand level
c. Keeping on line
d. Reading a chain
e. Plumbing while chaining
f. Using chaining pins

Provide Practical Application On:

a. Reading a chain
b. Rear chaining
c. Using hand level
d. Plumbing

INSTRUCTIONAL MATERIALS

Textbooks:

McCormac, Surveying

Tools and Equipment:

a. Plumb bob
b. Hand level
c. 100 ft. chain
d. Range pole
e. Chaining pins

LAB HOURS	18
CLASS HOURS	6

EVALUATION (MD-01)

a. Given a written exam covering various methods of measuring distances, equipment used in measuring and the responsibilities of a rear chainperson, the student will score at least 70%.

b. Given a 100 ft. chain, range pole, plumb bob, hand level and chaining pins, the student will chain a traverse of over 1000 feet to a precision of 1 foot or less in 3000 feet.

TASK

MD-02 Performing head chaining-horizontal

PERFORMANCE OBJECTIVE

Perform head chaining - horizontal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Horizontal chaining
b. Types of chains
c. Reading a chain
d. Using a hand level
e. Using a plumb bob
f. Using chaining pins

Provide Demonstration On:

a. Using a chain
b. Using a hand level
c. Plumbing while chaining
d. Reading a chain
e. Using chaining pins

Provide Practical Application On:

a. Head chaining under varying field conditions
b. Reading a chain

INSTRUCTIONAL MATERIALS

Textbooks:

McCormac, Surveying

Tools and Equipment:

a. Plumb bob
b. Hand level
c. 100 ft. chain
d. Range pole
e. Chaining pins

LAB HOURS	18
CLASS HOURS	6

EVALUATION (MD-02)

a. Given a written exam covering various methods of measuring distances, chaining equipment, errors and mistakes made in chaining and responsibilities of a head chainperson, the student will score at least 70%.

b. Given a 100 ft. chain, range pole, plumb bob, hand level and chaining pins, the student will chain a traverse of over 1000 feet to a precision of 1 foot of less in 3000 feet.

TASK

MD-03 Maintaining chaining notes - horizontal

PERFORMANCE OBJECTIVE

Maintain proper chaining notes - horizontal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Civil lettering
b. Setting up a fieldbook
c. Errors and mistakes in notekeeping
d. Rules for entering and/or correcting data

Provide Demonstration On:

a. Proper notekeeping techniques
b. Civil lettering

Provide Practical Application On:

a. Field notekeeping
b. Lettering
c. Interpreting field notes prepared by others

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pafford, Handbook of Survey Notekeeping
b. McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. 4H pencil
c. Straight edge

LAB HOURS	18
CLASS HOURS	6

EVALUATION (MD-03)

On an actual field chaining survey, the student will use proper notekeeping techniques and accurately, completely and clearly maintain a complete set of chaining notes. The instructor will check notes for clarity and accuracy.

TASK

MD-04 Performing rear chaining - slope

PERFORMANCE OBJECTIVE

Perform rear chaining - slope.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Limitations of horizontal chaining
b. Slope chaining procedures
c. Duties of rear chainperson
d. Use of hand clinometer
e. Use of transit for slope
f. Problems encountered with tapes longer than 100 feet
g. Breaking chain

Provide Demonstration On:

a. Slope chaining techniques
b. Use of hand clinometer
c. Slope chaining to a transit station

Provide Practical Application On:

a. Rear slope chaining over various types of terrain
b. Rear slope chaining using a hand clinometer for slope
c. Rear slope chaining using a transit on station for slope

INSTRUCTIONAL MATERIALS

Textbooks:

McCormac, Surveying

Tools and Equipment:

a. Chain (100, 200 or 300 foot)
b. Plumb bob and sheath
c. Tape clamps
d. Chaining pins
e. Hand clinometer

LAB HOURS	18
CLASS HOURS	6

EVALUATION (MD-04)

Under actual field conditions, the student will perform the rear chaining duties of a chaining party on a closed traverse of at least 1000 feet in length. Fieldwork precision of distances must be 1 foot or less in 3000 feet.

TASK

MD-05 Performing head chaining - slope

PERFORMANCE OBJECTIVE

Perform head chaining - slope.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Duties of head chainperson
b. Tension required for long chains
c. Communication signals
d. Breaking chain

Provide Demonstration On:

a. Head chainperson techniques
b. Chaining to a transit on station

Provide Practical Application On:

a. Head slope chaining over variou types of terrain
b. Head slope chaining using a hand clinometer for slope
c. Head slope chaining using a transit for slope

INSTRUCTIONAL MATERIALS

Textbooks:

McCormac, Surveying

Tools and Equipment:

a. Chain (100, 200 or 300 foot)
b. Tape clamp
c. Tensioning device
d. Chaining pins
e. Hand clinometer
f. Plumb bob and sheath

LAB HOURS 18

CLASS HOURS 6

EVALUATION (MD-05)

Under actual field conditions, the student will perform head chaining duties of a chaining party on a closed traverse of at least 1000 feet in length. Fieldwork precision of distances must be 1 foot or less in 3000 feet.

TASK

MD-06 Maintaining chaining notes - slope

PERFORMANCE OBJECTIVE

Maintain chaining notes while slope chaining.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Slope chaining procedures
b. Various methods for slope determination
c. Notekeeping techniques for slope chaining

Provide Demonstration On:

Notekeeping techniques for slope chaining

Provide Practical Application On:

Notekeeping on a slope chaining crew over various types of terrain

INSTRUCTIONAL MATERIALS

Textbooks:

McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. 4H pencil
c. Straight edge

LAB HOURS	18
CLASS HOURS	6

EVALUATION (MD-06)

Under actual field conditions, the student will maintain a set of slope chaining fieldnotes totally free of data entry errors and conforming to guidelines furnished by the instructor.

TASK

ME-01 Understanding general leveling

PERFORMANCE OBJECTIVE

Understand the principal of leveling and the various types of leveling equipment used.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definitions and terminology
b. Types of leveling
c. Types of level rods
d. Care of equipment
e. Types of levels

Provide Demonstration On:

a. Types of levels
b. Care of equipment
c. Types of leveling

Provide Practical Application On:

a. Care of equipment
b. Types of leveling

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

Various types of levels

LAB HOURS	0
CLASS HOURS	6

EVALUATION (ME-01)

Given a written exam covering definitions and terminology, types of leveling, types of levels, level rods and care of equipment, the student will score at least 70%.

TASK

ME-02 Maintaining notes for level runs

PERFORMANCE OBJECTIVE

Maintain proper level notes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Level notekeeping
b. Leveling procedures
c. Definitions
d. Errors and mistakes
e. Hand signals
f. Differential leveling
g. Trig leveling

Provide Demonstration On:

a. Sample notekeeping formats
b. Leveling procedures

Provide Practical Application On:

a. Notekeeping under field conditions
b. Hand signaling under field conditions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Field book
b. 4H pencil
c. Straight edge

LAB HOURS	18
CLASS HOURS	6

EVALUATION (ME-02)

Given a written exam covering level notekeeping, leveling problems, definitions and errors and mistakes, the student will score at least 70%.

TASK

ME-03 Understanding leveling field procedures

PERFORMANCE OBJECTIVE

Understand the field procedure for various types of leveling.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Differential leveling
b. Trig leveling
c. Proper field procedures

Provide Demonstration On:

a. Leveling procedures
b. Differential leveling
c. Trig leveling

Provide Practical Application On:

a. Differential leveling procedures
b. Trig leveling procedures

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS	0
CLASS HOURS	6

EVALUATION (ME-03)

Given a written exam covering leveling procedures, differential leveling and trig leveling, the student will score at least 70%.

TASK

ME-04 Using the dumpy level

PERFORMANCE OBJECTIVE

Use the dumpy level.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of the level
b. Care of the level
c. Setting up a level
d. Focusing the level

Provide Demonstration On:

a. Care of the level
b. Use of the level

Provide Practical Application On:

Using a level under various field conditions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil
c. Dumpy level
d. Tripod
e. Philadelphia rod

LAB HOURS	18
CLASS HOURS	6

EVALUATION (ME-04)

Given a dumpy level, tripod and Philadelphia rod, the student will set up the dumpy level between two bench marks, taking a backsight on the bench mark of given elevation and a foresight on the bench mark of unknown elevation. The student will then compute the unknown elevation to within ±.03 ft. of the actual elevation in a time not to exceed five minutes.

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TASK

MA-01 Using the standard one-minute transit

PERFORMANCE OBJECTIVE

Use the standard one-minute transit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of a transit
b. Care of the transit
c. Setting up a transit
d. Focusing the transit
e. Reading the vernier

Provide Demonstration On:

a. Care of the transit
b. Setting a transit over a point
c. Reading the vernier
d. Using the transit
e. Turning angles

Provide Practical Application On:

a. Setting up a transit over a point on various types of terrain
b. Reading a one-minute vernier
c. Sighting a transit and turning angles

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil
c. Transit
d. Tripod
e. Plumb bob

LAB HOURS	4
CLASS HOURS	2

EVALUATION (MA-01)

Given a one minute plumb bob type transit, the student will set the instrument up over a given point and close the horizon on three points with a total error of closure not to exceed ±4 minutes of an arc and in a time not to exceed 20 minutes.

TASK

MA-02 Using a standard 30-second transit

PERFORMANCE OBJECTIVE

Use a standard 30-second transit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of a transit
b. Care of the transit
c. Setting up a transit
d. Focusing the transit
e. Reading the vernier

Provide Demonstration On:

a. Care and use of a transit
b. Setting a transit over a point
c. Reading the vernier
d. Turning angles

Provide Practical Application On:

a. Setting up a transit over points on various terrain
b. Reading the 30-second vernier
c. Turning angles

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil
c. Transit
d. Tripod
e. Plumb bob

LAB HOURS	4
CLASS HOURS	2

EVALUATION (MA-02)

Given a 30-second transit, the student will set the instrument up over a given point and close the horizon on three points with a total error of closure not to exceed ±2 minutes of an arc and in a time not to exceed twenty minutes.

TASK

MA-03 Using the standard 20-second transit

PERFORMANCE OBJECTIVE

Use the standard 20-second transit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of a transit
b. Care of the transit
c. Setting up a transit
d. Focusing the transit
e. Reading the vernier

Provide Demonstration On:

a. Care and use of a transit
b. Setting up a transit
c. Turning angles
d. Reading the vernier

Provide Practical Application On:

a. Setting up a transit under various field conditions
b. Reading the 20-second vernier
c. Turning angles

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil
c. Transit
d. Tripod
e. Plumb bob

LAB HOURS	4
CLASS HOURS	2

EVALUATION (MA-03)

Given a 20-second transit, the student will set the instrument up over a given point and close the horizon on three points with a total error of closure not to exceed 80 seconds of an arc and in a time not to exceed 20 minutes.

TASK

MA-04 Using the theodolite

PERFORMANCE OBJECTIVE

Demonstrate proper use of a theodolite.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Differences between a transit and theodolite
b. Parts nomenclature
c. Use of optical plummet
d. Set up procedure
e. Field transport procedure
f. Field care of the instrument
g. Reading the vernier
h. Procedure for turning angles

Provide Demonstration On:

a. Attachment onto tripod
b. Setting up over a point
c. Turning various types of angles
d. Field carrying techniques

Provide Practical Application On:

a. Setting up over points on various types of terrain
b. Closing the horizon around a point
c. Turning angles around a closed traverse

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Kissam, Surveying for Civil Engineers

Tools and Equipment:

a. Plumb bob
b. Theodolite
c. Tripod

LAB HOURS 18

CLASS HOURS 6

EVALUATION (MA-04)

Given a theodolite mounted on a tripod and a point on the ground, the student will set up the instrument and close the horizon on three other points at least 100 feet away. Time will not exceed 20 minutes. Angular error of closure will not exceed three times the least scale division of the horizontal vernier.

TASK

TR-01 Traversing with the standard transit and chain

PERFORMANCE OBJECTIVE

Traverse with the standard transit and chain.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definitions and terminology
b. Traversing procedures
c. Review transit use
d. Review chaining
e. Review giving line
f. Review notekeeping

Provide Demonstration On:

Traversing procedures

Provide Practical Application On:

Traversing with a standard transit and chaining

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Field book
b. 4H pencil
c. Transit
d. Tripod
e. Plumb bobs
f. Chaining equipment

LAB HOURS	18
CLASS HOURS	6

EVALUATION (TR-01)

As a member of a survey team, the student will measure distances and record data over a traverse of a length of 1000 feet and 5 points, with an angular error not to exceed one minute per point and a total precision of one foot or less in 5000 feet.

TASK

TR-02 Maintaining notes for transit traverses

PERFORMANCE OBJECTIVE

Maintain proper fieldnotes for a transit traverse.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of angles turned on a traverse
b. Typical layouts for angle notes
c. Field math check of angles for a closed traverse

Provide Practical Application On:

a. Angle notekeeping under field conditions
b. Angle notekeeping where different types of angles are turned

INSTRUCTIONAL MATERIALS

Textbooks:

a. McCormac, Surveying
b. Pafford, Handbook of Survey Notekeeping

Tools and Equipment:

a. Fieldbook
b. 4H pencil
c. Straight edge

LAB HOURS	18
CLASS HOURS	6

EVALUATION (TR-02)

Under actual field conditions, the student will accurately maintain a set of traverse fieldnotes for a transit party. Fieldnotes will be totally free of data entry errors and conform to guidelines furnished by the instructor.

TASK

TR-03 Setting points on line

PERFORMANCE OBJECTIVE

Set hubs and tacks on line with the transit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Need for establishing points on line
b. Field procedure
c. Common hand signals
d. Duties of each crew member

Provide Demonstration On:

a. Hand signals
b. Field procedure

Provide Practical Application On:

a. Establishing intermediate points on a line at random spacing
b. Establishing intermediate points on a line at fixed intervals

INSTRUCTIONAL MATERIALS

Textbooks:

McCormac, Surveying

Tools and Equipment:

a. Transit
b. Tripod
c. Hubs and tacks
d. Hammer and sledge hammer
e. Chain

LAB HOURS 4
CLASS HOURS 2

EVALUATION (TR-03)

Given the end points of a line, the student will use a standard transit and direct a crew, setting intermediate points along the line as specified by the instructor. Established points will be within ±0.01 foot of the given line.

TASK

TR-04 Bucking in on line

PERFORMANCE OBJECTIVE

Buck in on a line between two points not visible from each other.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Situations requiring bucking in
b. Field procedure

Provide Demonstration On:

Bucking in on a line

Provide Practical Application On:

Bucking in on a line

INSTRUCTIONAL MATERIALS

Textbooks:

McCormac, Surveying

Tools and Equipment:

a. Transit
b. Tripod
c. Plumb bob and sheath
d. Hubs and tacks
e. Hammer and sledge hammer

LAB HOURS	4
CLASS HOURS	2

EVALUATION (TR-04)

Given a line at least 200 feet long, the student will use a standard transit and buck in on the line at an intermediate point selected by the instructor in a time not to exceed 15 minutes.

TASK

TR-05 Prolonging a line

PERFORMANCE OBJECTIVE

Prolong a line by double centering.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Situations requiring prolonging a line
b. Hazards of short backsights
c. Field procedure

Provide Demonstration On:

Prolonging a line

Provide Practical Application On:

Prolonging a line

INSTRUCTIONAL MATERIALS

Textbooks:

McCormac, Surveying

Tools and Equipment:

a. Transit
b. Tripod
c. Plumb bob and sheath
d. Hubs and tacks
e. Hammer and sledge hammer

LAB HOURS	4
CLASS HOURS	2

EVALUATION (TR-05)

Using a standard transit, the student will set up the instrument over a given point, backsight on another given point, then give instructions to a chaining crew to prolong the line by double centering in a time not to exceed 15 minutes.

TASK

TR-06 Deflecting around an object

PERFORMANCE OBJECTIVE

Deflect around an object while running a true line.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Situations requiring deflecting around objects
b. Field procedure

Provide Demonstration On:

Deflecting around an object

Provide Practical Application On:

Deflecting around an object

INSTRUCTIONAL MATERIALS

Textbooks:

Davis, Foote and Kelly, Survey: Theory and Practice

Tools and Equipment:

a. Transit
b. Tripod
c. Chaining equipment

LAB HOURS	4
CLASS HOURS	2

EVALUATION (TR-06)

Given a standard transit and a line with an obstacle along an extension of the line, the student will deflect around the obstacle while prolonging the line and set a third point in a time not to exceed 45 minutes. Third point must be placed within 1 foot or less in 3000 feet of the correct position.

TASK

SM-01 Understanding rounding and significant digits

PERFORMANCE OBJECTIVE

Calculate values according to rules for rounding and significant digits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Need for standard rules for computing
b. Rule for rounding
c. Significant digits

Provide Demonstration On:

a. How not using significant digits can misrepresent measurements
b. How improper rounding produces a cumulative error

Provide Practical Application On:

Computating length, area and volume involving both rounding and significant digits

INSTRUCTIONAL MATERIALS

Textbooks:

McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (optional)

LAB HOURS	0
CLASS HOURS	6

EVALUATION (SM-01)

Given a written computational exam on rounding and significant digits, the student will score at least 80%. Use of a calculator is at the discretion of the instructor.

TASK

SM-02 Understanding surveying errors and precision

PERFORMANCE OBJECTIVE

Differentiate between surveying accuracy, error and precision.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definitions:
    1. Accuracy
    2. Precision
    3. Errors
        a) accidental
        b) systematic
        c) probable
    4. Mistakes
b. Typical field examples

Provide Demonstration On:

a. Personal errors
b. Typical "blunders"
c. Instrumental errors
d. Natural errors

Provide Practical Application On:

a. Computing precision ratio
b. Computing probable error for different measuring devices

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (optional)

LAB HOURS	0
CLASS HOURS	6

EVALUATION (SM-02)

Given a written exam covering definitions, examples and computations of surveying errors and precision, the student will score at least 80%. Use of a calculator is at the discretion of the instructor.

TASK

SM-03 Performing angle computations

PERFORMANCE OBJECTIVE

Perform mathematical computations using angular measurement.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The "degree" system of angular measurement
b. Conversions:
   1. D.M.S. to D.DD
   2. D.DD to D.M.S.
c. Math operations using degrees:
   1. Addition
   2. Subtraction
   3. Multiplication
   4. Division

Provide Demonstration On:

Mathematical computations using angular measurement

Provide Practical Application On:

a. Various problems involving addition, subtraction, multiplication and division of angles
b. Problems requiring degree measurements to be converted to and from decimal equivalent

INSTRUCTIONAL MATERIALS

Textbooks:

a. Herubin, Principles of Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (optional)

LAB HOURS	0
CLASS HOURS	6

EVALUATION (SM-03)

Given a written computational exam on angular measurement and angular addition, subtraction, multiplication and division, the student will score at least 80%. Use of a calculator is at the discretion of the instructor.

TASK

SM-04 Computing traverse directions

PERFORMANCE OBJECTIVE

Computing traverse directions using azimuths, bearings, angles and declination.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Direction systems:
   1. Meridans
   2. Azimuths
   3. Bearings
b. The compass:
   1. Declination
   2. Local attraction
c. Traverse angles
d. Traverse computations
e. Declination computations

Provide Demonstration On:

Computing traverse directions

Provide Practical Applications On:

a. Computing bearings from azimuths
b. Computing azimuths from bearings
c. Computing traverse directions from various angles
d. Computing true direction from azimuth or bearing given declination

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (optional)
d. Isogonic chart (current)

LAB HOURS 0

CLASS HOURS 6

EVALUATION (SM-04)

Given a written computational exam on traverse directions, the student will score at least 80%. Use of a calculator is at the discretion of the instructor.

TASK

SM-05 Performing right triangle computations

PERFORMANCE OBJECTIVE

Perform right triangle computations using basic trig functions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of a right triangle
b. Pythagorean theorem
c. Sin, cos, tan functions
d. Arc sin, arc cos, arc tan functions
e. Use of scientific calculator (must have trig functions)
f. Use of trig tables (optional)

Provide Practical Application On:

a. Pythagorean problems
b. Right triangle problems

INSTRUCTIONAL MATERIALS

Textbooks:

Any shop math textbook

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (with trig functions)
d. Trig tables (optional)

LAB HOURS	0
CLASS HOURS	6

EVALUATION (SM-05)

Given a written computational exam where any three parts of a right triangle are given and the remaining three parts must be calculated, the student will score at least 80%. Use of a calculator or trig tables is at the discretion of the instructor.

TASK

SM-06 Correcting distance measurements

PERFORMANCE OBJECTIVE

Correct distance measurements for temperature, slope and length of tape.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Temperature corrections
b. Slope corrections
c. Wrong tape length corrections
d. Combined corrections

Provide Demonstration On:

a. How a "short (cold)" tape increases measurement
b. How a "long (hot)" tape decreases measurement

Provide Practical Application On:

a. Individual corrections
b. Combined corrections

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (optional)

LAB HOURS 0
CLASS HOURS 6

EVALUATION (SM-06)

Given a written computational exam on single and combined corrections for distance measurements, the student will score at least 80%. Use of a calculator is at the discretion of the instructor.

TASK

SM-07 Computing latitudes and departures

PERFORMANCE OBJECTIVE

Compute the latitude and departure of a line.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Balancing field angles
b. Calculating traverse bearings
c. Computation of latitudes
d. Computation of departures
e. Computation of error of closure
f. Computation of precision of the field survey
g. Approximating location of field errors

Provide Demonstration On:

a. Use of a standard traverse computation form to reduce mistakes
b. Use of error in latitude and departure in approximating location of field error

Provide Practical Application On:

a. Completing traverse computations
b. Determining location of field error, using error in latitude and departure

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper (standard form recommended)
c. Calculator (recommended)
d. Traverse computation form

LAB HOURS	0
CLASS HOURS	6

EVALUATION (SM-07)

Given a closed traverse, all distances, initial bearing and unadjusted field angles, the student will calculate the precision of the survey using a standard form for traverse computations. All answers will be correct to the fourth decimal place. Use of a calculator is allowed.

TASK

SM-08 Balancing a closed traverse

PERFORMANCE OBJECTIVE

Balance the latitudes and departures of a closed traverse.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Precision required for balancing
b. The compass method of balancing
c. Math check of balanced latitudes and departures

Provide Demonstration On:

Balancing a closed traverse

Provide Practical Application On:

Balancing various closed traverses by the compass method

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (recommended)
d. Traverse computation form

LAB HOURS	0
CLASS HOURS	6

EVALUATION (SM-08)

Given a closed traverse with pre-computed latitudes and departures, the student will balance the latitudes and departures using the compass method and a calculator, answers must be correct to the fourth decimal place.

TASK

SM-09 Computing the area of a closed traverse

PERFORMANCE OBJECTIVE

Compute the area of a closed traverse.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Area by double meridian distances (D.M.D.)
b. Area by cross multiplication of coordinates

Provide Practical Application On:

a. Computing area by D.M.D.
b. Computing area by cross multiplication of coordinates

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper
c. Traverse computation form
d. Calculator

LAB HOURS	0
CLASS HOURS	6

EVALUATION (SM-09)

Given a pre-computed and balanced closed traverse, the student will compute the area of the figure by the method selected by the instructor. Answer will be correct to within ±0.002 acres. A calculator may be used.

TASK

SM-10 Computing coordinates of a traverse

PERFORMANCE OBJECTIVE

Compute the coordinates of all points of a traverse.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Coordinate systems
b. Computing coordinates
c. Math check for coordinates in a closed traverse

Provide Practical Application On:

Computing coordinates of various closed traverse

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper
c. Traverse computation form
d. Calculator (recommended)

LAB HOURS	0
CLASS HOURS	6

EVALUATION (SM-10)

Given a pre-computed and balanced traverse with starting coordinates, the student will compute all other coordinates. All coordinates will be correct to the fourth decimal place. A calculator may be used.

TASK

SM-11 Computing closed traverses

PERFORMANCE OBJECTIVE

Perform complete traverse computations from field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Recommended procedure for office computations
b. Use of traverse computation form
c. Required accuracy and precision of data
d. Maintaining significant digits (4) until computing final coordinates

Provide Practical Application On:

Performing complete traverse computations from field data

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Pencil
b. Paper
c. Traverse computation forms
d. Calculator (recommended)

LAB HOURS 0

CLASS HOURS 24

EVALUATION (SM-11)

Given a complete set of field notes of a closed traverse, the student will use a traverse computation form to compute down to coordinates of each point. Final coordinates will be within ±0.01 foot of the correct value. A calculator is recommended.

TASK

SM-12 Inversing between coordinates

PERFORMANCE OBJECTIVE

Inverse between two points of known coordinates.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Establishing control by random traverses
b. Side shots
c. Inversing for distance and direction

Provide Demonstration On:

Inversing between coordinates

Provide Practical Application On:

Inversing between points of known coordinates

INSTRUCTIONAL MATERIALS

Textbooks:

Brinker, Elementary Surveying

Tools and Equipment:

a. Paper
b. Pencil

LAB HOURS	0
CLASS HOURS	6

EVALUATION (SM-12)

Given a written test on inversing between points of known coordinates, the student will score at least 80%.

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TASK

SM-13 Computing distance-distance intersections

PERFORMANCE OBJECTIVE

Compute coordinates of a point using two known distances.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Situations requiring "D-D" intersections
b. Intersection trigonometry
c. Specific method for solving "D-D" intersection

Provide Practical Application On:

a. Computing coordinates of a point using distance-distance intersection computation
b. Identifying situations requiring "D-D" method

INSTRUCTIONAL MATERIALS

Textbooks:

Davis, Foot and Kelly, Survey: Theory and Practice

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (recommended)

LAB HOURS	0
CLASS HOURS	12

EVALUATION (SM-13)

Given two points of known coordinates, the student will compute the coordinates of a third point knowing the distance from the known points to the third point. Answer will be correct to the fourth decimal place. A calculator may be used.

TASK

SM-14 Computing distance-bearing intersections

PERFORMANCE OBJECTIVE

Compute coordinates of a point using a known distance and bearing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Situations requiring "D-B" intersections
b. Intersection trigonometry
c. Specific method for solving "D-B" intersection

Provide Practical Application On:

a. Computing coordinates of a point using distance-bearing computations
b. Identifying situations requiring "D-B" method

INSTRUCTIONAL MATERIALS

Textbooks:

Davis, Foote and Kelly, *Survey: Theory and Practice*

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (recommended)

LAB HOURS	0
CLASS HOURS	12

EVALUATION (SM-14)

Given two points of known coordinates (A and B), the student will compute the coordinates of a third point (C) where distance A-C and bearing B-C are known. Answer will be correct to the fourth decimal place. A calculator may be used.

TASK

SM-15 Computing bearing-bearing intersections

PERFORMANCE OBJECTIVE

Compute coordinates of a point using two known bearings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Situations requiring "B-B" intersections
b. Intersection trigonometry
c. Specific method for solving "B-B" intersections

Provide Practice Application On:

a. Computing coordinates of a point using bearing-bearing intersection computation
b. Identifying situations requiring "B-B" method

INSTRUCTIONAL MATERIALS

Textbooks:

Davis, Foote and Kelly, Survey: Theory and Practice

Tools and Equipment:

a. Pencil
b. Paper
c. Calculator (recommended)

LAB HOURS	0
CLASS HOURS	12

EVALUATION (SM-15)

Given two points of known coordinates, the student will compute the coordinates of a third point where the bearings from the known points to the third point are known. Answer will be correct to the fourth decimal place. A calculator may be used.

TASK

SM-16 Using a programmable calculator

PERFORMANCE OBJECTIVE

Program a calculator to solve surveying problems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Problem solving techniques:
   1. Flowcharting
   2. Step method
b. Basic programming:
   1. Algebraic notation
   2. Reverse polish notation
c. Surveying applications
d. Building a reference library of surveying programs

Provide Demonstration On:

a. Programming - algebraic method
b. Programming - reverse polish method

Provide Practical Application On:

a. Writing, programming and using programs in solving surveying problems
b. Building a library of programs designed for surveying problems

INSTRUCTIONAL MATERIALS

Textbooks:

Owner's manual for specific calculator

Tools and Equipment:

a. Pencil
b. Paper
c. A programmable calculator
d. Owner's manual for calculator

LAB HOURS	0
CLASS HOURS	12

EVALUATION (SM-16)

Given a typical surveying problem requiring computation, the student will design, write, program and execute the problem on a programmable calculator. The program will run error-free, be easily re-executable, supply answers to at least four decimal places and work on normal variations of the given problem.

TASK

BDP-01 Understanding drafting definitions, symbols and terminology

PERFORMANCE OBJECTIVE

Identify and define terminology and symbols common to civil drafting.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Drafting as a technical language
b. Concepts of:
    1. Plan
    2. Elevations
    3. Profiles
c. Civil drafting symbols

Provide Practical Application On:

a. Identifying drafting symbols
b. Defining terms relating to plans, elevations and profiles

INSTRUCTIONAL MATERIALS

Textbooks:

Luzadder, Fundamentals of Engineering Drawing

Tools and Equipment:

Drafting kit (see reverse for contents)

LAB HOURS	0
CLASS HOURS	6

EVALUATION (BDP-01)

Given a written test on civil drafting definitions, terminology and symbols, the student will score at least 80%.

Drafting Kit

a. 2H and 4H pencils
b. Drafting eraser
c. Erasing shield
d. 12" 30° - 60° triangle
e. 10" 45° triangle
f. 5" center wheel compass with pen attachment
g. 12" civil engineer's scale
h. Drafting board or table
i. T-square, parallel straight edge or drafting machine
j. 360° circular protractor (10")
k. Pencil pointing device
l. Drafting brush
m. Drafting tape
n. Lettering guide

TASK

BDP-02 Using drafting instruments

PERFORMANCE OBJECTIVE

Demonstrate the proper use and care of various drafting instruments.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Names of all drafting equipment
b. Function of each piece of drafting equipment
c. Care and maintenance of drafting equipment

Provide Demonstration On:

How each piece of drafting equipment is used

Provide Practical Application On:

a. Identifying drafting equipment
b. Describing the function of drafting equipment
c. Care and maintenance of drafting equipment

INSTRUCTIONAL MATERIALS

Textbooks:

Luzadder, *Fundamentals of Engineering Drawing*

Tools and Equipment:

Drafting kit

LAB HOURS	4
CLASS HOURS	2

EVALUATION (BDP-02)

Given criteria supplied by the instructor, the student will demonstrate satisfactory usage, care and maintenance of all drafting equipment.

TASK

BDP-03 Lettering on engineering drawings

PERFORMANCE OBJECTIVE

Letter in accordance with engineering practice.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Single stroke letters
b. Letter proportions
c. Guidelines and slope lines (lettering guide)
d. Uniformity and stability
e. Freehand lettering:
    1. Vertical
    2. Slant

Provide Demonstration On:

a. Single stroke lettering technique
b. Letter spacing and composition

Provide Practical Application On:

Lettering, using vertical and slant gothic letters

INSTRUCTIONAL MATERIALS

Textbooks:

Luzadder, Fundamentals of Engineering Drawing

Tools and Equipment:

Drafting kit

LAB HOURS	16
CLASS HOURS	2

EVALUATION (BDP-03)

Given criteria supplied by the instructor, the student will demonstrate proper engineering lettering on a series of lettering plates.

TASK

BDP-04 Performing linework

PERFORMANCE OBJECTIVE

Demonstrate proper linework on actual drawings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The alphabet of lines (ANSI standards)
b. Layout techniques
c. Maintaining neatness
d. Pencil control for constant width lines
e. Line intersections

Provide Demonstration On:

Examples of adequate linework

Provide Practical Application On:

Drawing the various types of lines

INSTRUCTIONAL MATERIALS

Textbooks:

Luzadder, Fundamentals of Engineering Drawing

Tools and Equipment:

Drafting kit

LAB HOURS	16
CLASS HOURS	2

EVALUATION (BDP-04)

Given criteria supplied by the instructor, the student will demonstrate proper linework on a series of assigned drawings.

TASK

BDP-05 Using a civil engineering scale

PERFORMANCE OBJECTIVE

Determine and lay off scale measurements with a civil engineer's scale.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Concepts of scales and reduction
b. Various types of scales:
    1. Architectural
    2. Mechanical
    3. Civil
c. Measuring drawings to determine actual length
d. Laying off a scale actual length on a drawing

Provide Demonstration On:

a. Measuring off of a drawing to determine actual length
b. Laying off a scale measurement on a drawing

Provide Practical Application On:

Interpreting various lengths of lines on a drawing using the civil engineer's scale

INSTRUCTIONAL MATERIALS

Textbooks:

Luzadder, Fundamentals of Engineering Drawing

Tools and Equipment:

Drawing kit

LAB HOURS	8
CLASS HOURS	4

EVALUATION (BDP-05)

Given a written test using the civil engineer's scale to both read off and lay off scale measurements representing actual length lines, the student will score at least 80%.

TASK

BDP-06 Recognizing drafting media

PERFORMANCE OBJECTIVE

Recognize various types of drafting media.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tracing paper
b. Drafting vellum
c. Cross-section paper
d. Plan and profile paper
e. Print duplicating paper
f. Mylar

Provide Practical Application On:

a. Identifying various samples of drafting media
b. Explaining the use of each type media

INSTRUCTIONAL MATERIALS

Textbooks:

Luzadder, Fundamentals of Engineering Drawing

LAB HOURS	0
CLASS HOURS	6

EVALUATION (BDP-06)

Given a written test on drafting media identification and uses, the student will score at least 80%.

TASK

BDP-07 Performing print duplication

PERFORMANCE OBJECTIVE

Utilize a blueprint machine to duplicate engineering drawings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Necessity for "blueprints"
b. Operating procedures
c. Printing:
    1. Bluelines
    2. Sepias
d. Printing from "difficult" originals:
    1. Print density control
    2. Line quality control

Provide Demonstration On:

a. Print machine:
    1. Start up
    2. Normal operating procedure
    3. Shut down and routine maintenance
b. Printing from varied quality originals

Provide Practical Application On:

a. Normal machine procedures
b. Printing from good quality originals
c. Printing from lesser quality originals
d. Printing sepias

INSTRUCTIONAL MATERIALS

Textbooks:

a. Luzadder, Fundamentals of Engineering Drawing
b. Operating manual for specific machine

Tools and Equipment:

a. Print machine
b. Print paper

LAB HOURS	8
CLASS HOURS	4

EVALUATION (BDP-07)

Given a blueprint machine and original drawing, the student will start up the machine, run a print and shut down the machine following manufacturer's recommended practices. Print will be of readable quality with little or no background color depending on the quality of the original.

TASK

RD-01 Drafting preliminary profiles

PERFORMANCE OBJECTIVE

Draft preliminary route profiles from field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose
b. Field methods of data collection:
    1. Transit-tape
    2. Transit-stadia
    3. Planetable
c. Mapping field data:
    1. Plans and profiles
    2. Scale
d. Establishing grades
e. Rough balancing cuts and fills

Provide Demonstration On:

a. Drawing center line from field data (stationing)
b. Drawing profile from field data
c. Locating grades

Provide Practical Application On:

Layout and drafting from actual field data:
a. Centerline
b. Complete plan of route
c. Profile of route
d. Finish (design) grades

INSTRUCTIONAL MATERIALS

Textbooks:

Davis, Foote and Kelly, Survey: Theory and Practice

Tools and Equipment:

a. Drafting kit
b. Plan and profile paper

LAB HOURS 16

CLASS HOURS 4

EVALUATION (RD-01)

Given an actual set of field data, the student will draw a preliminary plan and profile with design grades. Drawing will conform to criteria supplied by the instructor based upon State Department of Transportation formats for highway drawings.

TASK

RD-02 Drafting preliminary cross-sections

PERFORMANCE OBJECTIVE

Draft preliminary cross-sections from field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose
b. Field methods of data collection
c. Drawing original grade
d. Drawing finish grades:
    1. Cut section
    2. Fill section
    3. Combination section
e. Determining volume:
    1. Use of planimeter
    2. Volume formulas
f. Cut, fill and hall computations
g. Mass haul computations
h. Adjusting finish grade to balance cut and fill

Provide Demonstration On:

a. How field data is gathered
b. Making a cross-section template for ease in drawing sections
c. Using polar planimeter

Provide Practical Application On:

Layout, drafting and computing:
a. Cross-sections
b. Area of cut/fill at each station
c. Volume of cut/fill between stations
d. Mass haul
e. Adjustment of finish grade and recomputation of #1-#4 above

INSTRUCTIONAL MATERIALS

Textbooks:

Davis, Foote and Kelly, Survey: Theory and Practice

Tools and Equipment:

a. Drafting kit
b. Cross-section paper
c. Polar planimeter

LAB HOURS	16
CLASS HOURS	4

EVALUATION (RD-02)

Given an actual set of field data, the student will draft cross-sections and perform all computations necessary to balance cuts and fills for the route. Drawing will conform to criteria supplied by the instructor based upon typical requirements of the State Department of Transportation.

TASK

RD-03 Drafting final construction drawings

PERFORMANCE OBJECTIVE

Draft final construction drawings from field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose and content of final drawings
b. Site plans
c. Pipelines and sewers
d. Routes
e. Control drawings

Provide Demonstration On:

Examples of a variety of final construction drawings

Provide Practical Application On:

Final drafting from field data of:
a. Routes
b. Building sites
c. Pipelines
d. Control surveys

INSTRUCTIONAL MATERIALS

Textbooks:

Davis, Foote and Kelly, *Survey: Theory and Practice*

Tools and Equipment:

Drafting kit

LAB HOURS	16
CLASS HOURS	4

EVALUATION (RD-03)

Given actual field data, the student will draft a final construction drawing of the project conforming to criteria supplied by the instructor.

TASK

MP-01 Plotting field data

PERFORMANCE OBJECTIVE

Plot field data from a topographic survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Determining scale of map
b. Drawing control stations
c. Field methods:
    1. Planetable
    2. Transit stadia
    3. Starburst (radial)
d. Plotting field data

Provide Demonstration On:

a. Determining scale of map from control data
b. Typical drafting methods of plotting

Provide Practical Application On:

Plotting field data from field surveys by:
a. Transit-stadia methods
b. Starburst methods

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Luzadder, Fundamentals of Engineering Drawing

Tools and Equipment:

Drafting kit

LAB HOURS	14
CLASS HOURS	4

EVALUATION (MP-01)

Given topographic field data, the student will select an appropriate scale, establish control on the map and plot all topographic data using criteria supplied by the instructor.

TASK

MP-02 Interpreting and plotting contours

PERFORMANCE OBJECTIVE

Interpret and plot contour lines from field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Methods of interpretation:
   1. Mathematical
   2. Observational
b. Contour intervals
c. Properties of contours
d. Critical contour points:
   1. Peaks
   2. Depressions
   3. Ridges
   4. Streams
e. Required topographic accuracy

Provide Demonstration On:

a. Each property of contour lines (Brinker lists 14 properties)
b. Interpreting field data by:
   1. Mathematical means
   2. Observation (inspection)

Provide Practical Application On:

Plotting contours from field data:
a. Using different methods of interpretation
b. From field data covering different types of terrain

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Luzadder, Fundamentals of Engineering Drawing
c. McCormac, Surveying

Tools and Equipment:

Drafting kit

LAB HOURS	14
CLASS HOURS	4

EVALUATION (MP-02)

Given actual field data, the student will interpret and draw contour lines at the specified contour interval. Not more than 10% of all points checked will vary in horizontal accuracy more than 1/30 inch and in vertical accuracy more than 1/2 the contour interval.

TASK

MP-03 Using topographic symbols and conventions

PERFORMANCE OBJECTIVE

Complete a topographic drawing by utilizing the necessary symbols and conventions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Standard topographic symbols
b. Topographic conventions:
    1. Meridian arrow
    2. Title
    3. Notes

Provide Practical Application On:

a. Completing topographic maps
b. Utilizing standard topographic symbols and conventions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Luzadder, Fundamentals of Engineering Drawing
c. McCormac, Surveying

Tools and Equipment:

Drafting kit

LAB HOURS	14
CLASS HOURS	4

EVALUATION (MP-03)

Given a worksheet containing rough contour lines from field data, the student will draw a finished topographic map according to criteria supplied by the instructor and using standard topographic symbols and conventions.

TASK

PL-01 Drafting land plats

PERFORMANCE OBJECTIVE

Draft a land plat from field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Legality of land plats
b. Necessity for error-free drafting
c. Information contained on land plats
d. Typical symbols and conventions
e. Checking legal description against plat

Provide Demonstration On:

Examples of land plats from various counties

Provide Practical Application On:

a. Drafting land plats from field data
b. Double checking plats drawn by others
c. Comparing legal description against plat

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, *Elementary Surveying*
b. Luzadder, *Fundamentals of Engineering Drawing*
c. McCormac, *Surveying*

Tools and Equipment:

Drafting kit

LAB HOURS	54
CLASS HOURS	6

EVALUATION (PL-01)

Given actual field data, the student will draft a finished land plat acceptable for recording in the county in which the land exists.

TASK

PL-02 Drafting subdivision plats

PERFORMANCE OBJECTIVE

Draft subdivision plats from field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Content of subdivision plats
b. County requirements of subdivision plats

Provide Demonstration On:

Examples of subdivision plats from various counties

Provide Practical Application On:

a. Drafting subdivision plats from field data
b. Comparing lot descriptions with subdivision plat

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Luzadder, Fundamentals of Engineering Drawing
c. McCormac, Surveying

Tools and Equipment:

Drafting kit

LAB HOURS	54
CLASS HOURS	6

EVALUATION (PL-02)

Given actual field data, the student will draft a complete subdivision plat according to specifications of the county in which the land exists.

TASK

BS-01 Understanding boundary definitions and terminology

PERFORMANCE OBJECTIVE

Know the meaning of the terms used in the field of boundary surveying.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Legal terms
b. Surveying terms

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brown, Boundary Control and Legal Principles
b. Brown, Evidence and Procedures for Boundary Location
c. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS	0
CLASS HOURS	6

EVALUATION (BS-01)

Given a written test convering definitions of terms and the terminology used in boundary surveying, the student will score at least 70%.

TASK

BS-02 Understanding the historical perspective of land surveying

PERFORMANCE OBJECTIVE

Know the historical basis of land surveying.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. History of surveying
b. Early surveying methods
c. Early surveying equipment
d. Early land ownership

Provide Demonstration On:

Early surveying equipment and methods

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brown, Evidence and Procedures for Boundary Location
b. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS 0
CLASS HOURS 6

EVALUATION (BS-02)

Given a written test covering the history and development of land surveying, the student will score at least 70%.

TASK

BS-03 Understanding the legal basis of land surveying

PERFORMANCE OBJECTIVE

Know the legal aspects of boundary surveying.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Ownership of land
b. Transfer of real property
c. Legal descriptions of land
d. Statutory proceedings
e. Plat and subdivision laws
f. Eminent domain
g. Adverse rights
h. Riparian rights
i. Evidence of ownership

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brown, Boundary Control and Legal Principles
b. Brown, Evidence and Procedures for Boundary Location
c. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS	0
CLASS HOURS	6

EVALUATION (BS-03)

Given a written test covering the legal aspects of boundary surveying, the student will score at least 70%.

TASK

BS-04 Identifying evidence

PERFORMANCE OBJECTIVE

Determine what is legal evidence used in boundary location and surveying.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. What is evidence
b. Sources of evidence:
    1. Written
    2. Unwritten
    3. Field
c. Where to look for evidence
    1. In the field
    2. At the court house
    3. At the archives
d. Monuments

Provide Demonstration On:

a. Identifying field evidence
    1. Monuments
    2. Possessional limits
b. Reading and understanding written legal descriptions

Provide Practical Application On:

a. Looking for field evidence under actual surveying conditions
b. Reading various types of legal descriptions

INSTRUCTIONAL MATERIALS

Textbooks:

Brown, Evidence and Procedures for Boundary Location

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS	0
CLASS HOURS	6

EVALUATION (BS-04)

Given a written test covering types of evidence, sources of evidence, searching for evidence and monuments, the student will score at least 70%.

TASK

BS-05 Determining senior evidence

PERFORMANCE OBJECTIVE

Rank evidence in order of importance (senior) to determine the location of boundary lines.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of evidence
b. Rules for ranking evidence
c. Laws that effect evidence
   1. Adverse possession
   2. Riparian rights
   3. Eminent domain

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brown, Boundary Control and Legal Principles
b. Brown, Evidence and Procedures for Boundary Location

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS	0
CLASS HOURS	6

EVALUATION (BS-05)

Given a package of gathered evidence including written and field evidence on an actual piece of property, the student will determine the senior evidence in which boundary locations should be based and report to instructor. The instructor will discuss the report with the student and evaluate.

TASK

BS-06 Conducting legal research - tax office

PERFORMANCE OBJECTIVE

Conduct research at the local county tax office.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. What information can be found
b. Value of information found
c. Reasons for using tax office records

Provide Demonstration On:

Researching tax records

Provide Practical Application On:

Researching at tax office

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS 9

CLASS HOURS 3

EVALUATION (BS-06)

The student will discuss with the instructor: what can be found, the value of what can be found and the reasons why you should use tax office records.

TASK

BS-07 Conducting legal research - superior court record room

PERFORMANCE OBJECTIVE

Conduct a title search of a piece of property at a superior court.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reading deeds
b. Grantor index
c. Grantee index
d. Plat index

Provide Demonstrations On:

Using:
a. Grantor index
b. Grantee index
c. Plat index

Provide Practical Application On:

Title searching property

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS 9

CLASS HOURS 3

EVALUATION (BS-07)

Given the current owner and address of a piece of property, the student will go to the local courthouse and search the title of of the property back through at least four owners or 60 years. The instructor should have already searched the title and should evaluate student's findings.

TASK

BS-08 Conducting legal research - archives

PERFORMANCE OBJECTIVE

Use the archives as a source of information to aid in finding and evaluating evidence.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. How to use the archives
b. Types of evidence recorded at the archives

Provide Demonstration On:

Information recorded and maintained at archives

Provide Practical Application On:

Researching at the archives

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS	9
CLASS HOURS	3

EVALUATION (BS-08)

Orally discuss with the instructor what can be found at the archives.

TASK

BS-09 Understanding field procedures for boundary surveys

PERFORMANCE OBJECTIVE

Lead a field crew and perform a field boundary survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Review travsering
b. Review gathering field evidence
c. Adjoining property owner's rights
d. Protection of evidence
e. Setting up a traverse
f. Protection of trees, shrubs and plants
g. Trespassing

Provide Demonstration On:

a. Setting up a traverse
b. Locating evidence

Provide Practical Application On:

Working on boundary line location surveys

INSTRUCTIONAL MATERIALS

Textbooks:

Brown, *Evidence and Procedures for Boundary Locations*

Tools and Equipment:

a. Notebook
b. Pencil
c. Fieldbook
d. Traversing equipment

LAB HOURS 10
CLASS HOURS 2

EVALUATION (BS-09)

Working as a party chief, the student will lead a crew of men/ women and complete a boundary survey; including setting up of the traverse, location of evidence, performing the traverse and recording the data. This should be done on an actual piece of property if at all possible. (Example: school property) The instructor will evaluate for accuracy.

TASK

BS-10 Subdividing land

PERFORMANCE OBJECTIVE

Divide a given tract of land into two or more parcels.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Subdivision rules and regulations
b. Dividing irregular shaped tracts of land into equal segments

Provide Demonstration On:

Subdividing land

Provide Practical Application On:

Subdividing various types of property given various guide lines

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Drafting equipment
b. Pencil
c. Notebook

LAB HOURS	12
CLASS HOURS	6

EVALUATION (BS-10)

Given a boundary of a large tract of land, the student will subdivide the tract in accordance with given guidelines (subdivision rules). The instructor will evaluate for accuracy.

TASK

BS-11 Writing legal descriptions

PERFORMANCE OBJECTIVE

Write a legal description of a piece of property.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of descriptions
b. Metes and bounds
c. Points of beginning
d. What must be included in a legal description
e. Laws governing requirements of a legal description

Provide Demonstration On:

Various types of descriptions

Provide Practical Application On:

Writing descriptions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brown, Boundary Control and Legal Principles
b. Brown, Evidence and Procedures for Boundary Location

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS	0
CLASS HOURS	12

EVALUATION (BS-11)

Given a boundary plat of a piece of property, the student will prepare a complete and accurate metes and bounds written legal description. The instructor will evaluate for accuracy and completeness.

TASK

RS-01 Understanding route surveying definitions and terminology

PERFORMANCE OBJECTIVE

Know the meaning of the various terms used in route surveying.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

Various route surveying terms

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Hickerson, Route Location and Design
c. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil

LAB HOURS	0
CLASS HOURS	6

EVALUATION (RS-01)

Given a written test covering route surveying terms, the student will score at least 70%.

TASK

RS-02 Calculating horizontal curves

PERFORMANCE OBJECTIVE

Calculate the components of horizontal curves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of a curve
   1. Tangent
   2. Radius
   3. Length
   4. Long chord
   5. External
   6. Middle ordinate
   7. Degree of curve
   8. Delta
   9. Central angle
b. Math formulas

Provide Demonstration On:

Calculating components of horizontal curves

Provide Practical Application On:

Calculating components of horizontal curves

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Hickerson, Route Location and Design
c. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil
c. Calculator

LAB HOURS	0
CLASS HOURS	9

EVALUATION (RS-02)

Given a written test on curve computations, the student will score at least 70%.

TASK

RS-03 Calculating stakeout data for horizontal curves

PERFORMANCE OBJECTIVE

Calculate stakeout data for horizontal curves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Elements of curve layout
b. Calculating stakeout data from P.C., P.T. or intermediate stations

Provide Demonstration On:

Calculating stakeout data for horizontal curves

Provide Practical Application On:

Calculating stakeout data for horizontal curves

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Hickerson, Route Location and Design
c. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil
c. Calculator

LAB HOURS	0
CLASS HOURS	9

EVALUATION (RS-03)

Given a written test covering curve calculations, the student will score at least 70%.

TASK

RS-04 Calculating vertical curves

PERFORMANCE OBJECTIVE

Calculate the components of vertical curves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Vertical offsets from tangent to curve
b. Length of curve
c. Grades
d. Calculating "e"
e. Rate of change of grade
f. Curve elevations
g. Unsymmetrical curves
h. High or low point

Provide Demonstration On:

Calculating components of vertical curves

Provide Practical Application On:

Calculating components of vertical curves

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Hickerson, Route Location and Design
c. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil
c. Calculator

LAB HOURS	0
CLASS HOURS	9

EVALUATION (RS-04)

Given a written test covering curve calcuations, the student will score at least 70%.

TASK

RS-05 Calculating stakeout data for vertical curves

PERFORMANCE OBJECTIVE

Prepare stakeout data sheets for vertical curves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Figuring grades
b. Calculating curve elevations
c. Locating high or low point

Provide Demonstration On:

Calculating stakeout data for vertical curves

Provide Practical Applications On:

Calculating stakeout data for vertical curves

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Hickerson, Route Location and Design
c. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. 4H pencil
c. Calculator

LAB HOURS	0
CLASS HOURS	9

EVALUATION (RS-05)

Given a written test covering curve computations, the student will score at least 70%.

TASK

RS-06 Planning and designing route surveys

PERFORMANCE OBJECTIVE

Plan and design a route survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Design criteria
b. Design procedures
c. Methods of planning
d. Drafting techniques

Provide Demonstration On:

a. Planning
b. Designing

Provide Practical Application On:

a. Planning
b. Designing

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Hickerson, Route Location and Design
c. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil
c. Calculator
d. Drafting supplies

LAB HOURS 0

CLASS HOURS 6

EVALUATION (RS-06)

Given preliminary design data and field notes from a location survey, the student will design and prepare plans for a road at least 1500 feet long. The instructor will evaluate plans against design criteria.

TASK

RS-07 Computing earthwork quantities

PERFORMANCE OBJECTIVE

Compute earthwork quantities.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Cross-sections
b. Using a planimeter
c. Area computations
d. Average end method of earthwork quantities calculating

Provide Demonstration On:

a. Using a planimeter
b. Computing earthwork quantities

Provide Practical Application On:

a. Using a planimeter
b. Computing earthwork quantities

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Notebook
b. Pencil
c. Scale
d. Planimeter
e. Calculator

LAB HOURS 9

CLASS HOURS 3

EVALUATION (RS-07)

Given a set of cross sections and a planimeter, the student will calculate earthwork quantities. Quantities should be within 5% of the quantities calculated by the instructor.

TASK

RS-08 Staking out horizontal curves

PERFORMANCE OBJECTIVE

Set stakes for a series of horizontal curves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Elements of horizontal curves
b. Simple curves
c. Compound curves
d. Reverse curves
e. Stationing
f. Stakeout from P.C., P.T. and intermediate stations

Provide Demonstration On:

Stakeout procedures

Provide Practical Application On:

Setting stakes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Hickerson, Route Location and Design
c. McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. Straight edge
c. 4H pencil
d. Notebook
e. Chaining equipment
f. Transit and tripod
g. Hammer
h. Stakes

LAB HOURS 10

CLASS HOURS 0

EVALUATION (RS-08)

Working as a member of a team and given stakeout data, the student will set construction stakes for a series of curves that require stakeout from P.C., P.T. and intermediate stations. The instructor will evaluate field procedures and accuracy.

TASK

RS-09 Staking out vertical curves

PERFORMANCE OBJECTIVE

Set construction stakes for vertical curves and prepare a cut sheet for grades.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Vertical curves
b. Calculating grades
c. Calculating cut and fill
d. Field procedures
e. Notekeeping
f. Profiles

Provide Demonstration On:

Field procedures

Provide Practical Application On:

Setting stakes and calculating grades

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. Hickerson, Route Location and Design
c. McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. Straight edge
c. 4H pencil
d. Notebook
e. Chaining equipment
f. Transit and tripod
g. Level and tripod
h. Level rod
i. Hammer
j. Stakes

LAB HOURS 10

CLASS HOURS 0

EVALUATION (RS-09)

Working as a member of a team and given stakeout data, the student will set construction stakes, run profile levels and prepare a cut sheet for a series of vertical curves. Grades are to be accurate to ± .02 foot and stakes located to ± .02 foot.

TASK

RS-10 Staking out highway slopes

PERFORMANCE OBJECTIVE

Set slope stakes for road construction.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Calcuating slope stake location
b. Slope stakes for fill sections
c. Slope stakes for cut sections
d. Notekeeping

Provide Demonstration On:

Calculating and setting slope stakes

Provide Practical Application On:

Setting slope stakes

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Fieldbook
b. Straight edge
c. 4H pencil
d. Notebook
e. Chaining equipment
f. Hand level
g. Level rod
h. Level and tripod
i. Hammer
j. Stakes

LAB HOURS 10

CLASS HOURS 0

EVALUATION (RS-10)

Working as a member of a team and rotating duties, the student will take a field test consisting of setting 10 slope stakes on various slopes with an accuracy of ± .10 foot.

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TASK

CS-01 Conducting a reconnaissance survey

PERFORMANCE OBJECTIVE

Conduct a reconnaissance survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Elements of a reconnaissance survey
b. Utilizing existing maps
c. Utilizing aerial surveys
d. Field procedures
e. Notekeeping

Provide Demonstration On:

a. Utilizing existing maps and planning
b. Field procedures
c. Notekeeping

Provide Practical Application On:

Making a reconnaissance survey

INSTRUCTIONAL MATERIALS

Textbooks:

Hickerson, Route Location and Design

Tools and Equipment:

a. Fieldbook
b. Straight edge
c. 4H pencil
d. Notebook
e. Chaining equipment
f. Compass
g. Range poles
h. Hand level or abney level
i. Level rod

LAB HOURS	9
CLASS HOURS	1

EVALUATION (CS-01)

Working as a member of a team, the student will perform a reconnaissance survey for a proposed road of at least 2000 feet. The student should be given any available maps and design criteria before performing the needed field work. The instructor will check notes and field procedures for accuracy.

TASK

CS-02 Conducting a preliminary survey

PERFORMANCE OBJECTIVE

Conduct a preliminary survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Field procedures
b. Preliminary surveying
c. Notekeeping
d. Horizontal control
e. Vertical control

Provide Demonstration On:

a. Field procedures
b. Notekeeping

Provide Practical Application On:

Field procedures and preliminary surveying

INSTRUCTIONAL MATERIALS

Hickerson, Route Location and Design

Tools and Equipment:

a. Fieldbook
b. Straight edge
c. 4H pencil
d. Notebook
e. Chaining equipment
f. Transit and tripod
g. Stakes
h. Hammer
i. Range poles
j. Level
k. Tripod
l. Level rod

LAB HOURS 9

CLASS HOURS 1

EVALUATION (CS-02)

Working as a member of a team and given the beginning and ending points for a road of at least 2000 feet, the student will conduct a preliminary survey. The instructor will evaluate for accuracy and notekeeping.

TASK

CS-03 Conducting a location survey

PERFORMANCE OBJECTIVE

Conduct a location survey.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Elements of a location survey
b. Notekeeping
c. Field procedures
d. Cross sections

Provide Demonstration On:

a. Notekeeping
b. Field procedures

Provide Practical Application On:

Conducting location surveys

INSTRUCTIONAL MATERIALS

Textbooks:

Hickerson, Route Location and Design

Tools and Equipment:

a. Fieldbook
b. Straight edge
c. 4H pencil
d. Notebook
e. Chaining equipment
f. Transit and tripod
g. Range poles
h. Stakes
i. Hammer
j. Level
k. Level rod
l. Tripod

LAB HOURS	9
CLASS HOURS	1

EVALUATION (CS-03)

Given the preliminary design of a road at least 2000 feet long and working as a member of a team, the student will conduct a location survey. The instructor should fieldcheck work and evaluate fieldnotes.

TASK

CS-04 Conducting a pipeline survey

PERFORMANCE OBJECTIVE

Set construction stakes for a pipeline and prepare a cut sheet.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Center line staking and stationing
b. Offset staking
c. Calculating grades
d. Calculating cut and fill
e. Making a cut sheet
f. Profiles

Provide Demonstration On:

a. Calculating grades
b. Calculating cut and fill

Provide Practical Application On:

a. Staking
b. Calcuating grades
c. Calculating cut and fill

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. Straight edge
c. 4H pencil
d. Notebook
e. Chaining equipment
f. Transit and tripod
g. Level and tripod
h. Level rod
i. Hammer
j. Stakes

LAB HOURS 9

CLASS HOURS 1

EVALUATION (CS-04)

Working as a member of a team and given stakeout information, the student will set construction stakes and prepare a cut sheet for a pipeline of at least 1000 feet with three different grades and courses. The instructor will verify alignment and verify grades to ± .02 feet.

TASK

CS-05 Setting building batter boards

PERFORMANCE OBJECTIVE

Set batter boards for a building.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Need for batter boards
b. Where to locate batter boards
c. Setting batter boards
d. Checking batter boards

Provide Demonstration On:

a. Setting batter boards
b. Checking batter boards

Provide Practical Application On:

Setting batter boards

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. 4H pencil
c. Straight edge
d. Notebook
e. Chaining equipment
f. Transit and pripod
g. Level and tripod
h. Level rod
i. Hammer
j. Stakes

LAB HOURS	9
CLASS HOURS	1

EVALUATION (CS-05)

Working as a member of a team and given a set of building plans, the student will set batter boards. The instructor will evaluate accuracy of elevations to ± .01 feet and measurements to ± .02 feet.

TASK

CS-06 Performing subdivision construction staking

PERFORMANCE OBJECTIVE

Set property pins for the subdividing of land.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Good field procedures
b. Need for accuracy
c. Methods of making field checks

Provide Demonstration On:

Good field procedures

Provide Practical Application On:

Setting points

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Fieldbook
b. 4H pencil
c. Straight edge
d. Notebook
e. Chaining equipment
f. Transit and tripod
g. Stakes
h. Pins
i. Hammer

LAB HOURS	9
CLASS HOURS	1

EVALUATION (CS-06)

Working as a member of a team, the student will set corner markers from control points for a least three lots. All points must be located with an accuracy of ± .02 foot.

TASK

TS-01 Understanding topographic definitions and terminology

PERFORMANCE OBJECTIVE

Define and discuss topographic definitions and terminology.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Need for and uses of topographic surveys
b. Types of topographic surveys
c. Topographic field methods
    1. Ground
    2. Aerial
d. Establishing control
e. Critical ground details
f. Location of points in the field
g. Selection of field method
h. Topographic specifications
    1. Horizontal accuracy
    2. Vertical accuracy

Provide Demonstration On:

a. Examples of aerial and ground surveys
b. Examples of large and small scale maps

Provide Practical Application On:

a. Identifying most efficient field site constraints
b. Discussing the establishment of control for a given survey

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

LAB HOURS	0
CLASS HOURS	6

EVALUATION (TS-01)

Given a written test on topographic definitions and terminology, the student will score at least 80%.

TASK

TS-02 Using a planetable and alidade.

PERFORMANCE OBJECTIVE

Gather topographic field data with a planetable and alidade.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Planetable advantages
b. Setting up
c. Orientation by
    1. Compass
    2. Resection
    3. Backsighting
d. Traversing
e. Two and three point methods
f. Determining distance and elevation
    1. Stadia
    2. Beaman stadia arc
g. Sources of errors and mistakes

Provide Demonstration On:

a. Setting up
b. Orientation
c. Locating a ground point (distance and elevation)
d. Sketching while in the field

Provide Practical Application On:

Gathering field topographic data over various types of terrain using the planetable

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Planetable and tripod
b. Alidade
c. Stadia rod (or Philadelphia rod)
d. Field notebook
e. Scale
f. Drafting paper

LAB HOURS	10
CLASS HOURS	2

EVALUATION (TS-02)

Using a planetable, the student will map a given tract of land. Ninety percent (90%) of all points checked will have the following accuracy:

1. Horizontal: + 1/30 of an inch
2. Vertical: ± 1/2 the contour interval

TASK

TS-03 Using stadia for distance and elevation

PERFORMANCE OBJECTIVE

Use stadia for distance and elevation in gathering topographic field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Stadia with horizontal sights
b. Stadia with inclined sights
c. Stadia rods
d. Field notekeeping
e. Field procedure
f. Precision, errors and mistakes

Provide Practical Application On:

Gathering topographic field data over various types of terrain using stadia methods

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Standard transit with stadia hairs
b. Tripod
c. Stadia rod
d. Fieldbook and pencil

LAB HOURS 10

CLASS HOURS 2

EVALUATION (TS-03)

Given a standard transit with stadia set up over a control point, the student will backsight a control point of known elevation, compute the elevation of the instrument (H.I.), foresight on a ground point selected by the instructor and compute the elevation and distance to the ground point. Elevation must be within ± 1 foot and distance within ± 2 feet of the actual values.

TASK

TS-04 Field mapping using a grid system

PERFORMANCE OBJECTIVE

Use a grid system in gathering topographic field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Advantages of a grid
b. Establishing a grid
c. Coordination of transit and level crews
d. Field notekeeping
e. Locating controlling points
f. Accuracy, errors and mistakes

Provide Practical Application On:

Gathering topographic field data over various types of terrain using a grid system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Transit, tripod
b. Level, tripod, rod
c. Chain
d. Hubs, tacks
e. Hammer, sledge hammer
f. Field book

LAB HOURS	11
CLASS HOURS	1

EVALUATION (TS-04)

The student will direct a survey crew gathering topographic field data using a grid system. Work will proceed smoothly and be complete within the time limit set by the instructor. Ninety percent (90%) of all data gathered will conform to normal topographic accuracy.

TASK

TS-05 Field mapping using controlling points

PERFORMANCE OBJECTIVE

Use controlling points in gathering topographic field data.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Advantages of "shooting" just controlling points
b. Establishing control
c. Trace-contour method
d. Indirect (controlling point) method
e. Field notekeeping
f. Accuracy, errors and mistakes

Provide Demonstration On:

a. Trace-control method
b. Controlling point method

Provide Practical Application On:

Gathering topographic field data over various types of terrain using controlling point methods

INSTRUCTIONAL MATERIALS

Textbooks:

a. Brinker, Elementary Surveying
b. McCormac, Surveying

Tools and Equipment:

a. Transit, tripod, rod (transit with stadia hairs)
b. Field book

LAB HOURS 11

CLASS HOURS 1

EVALUATION (TS-05)

The student will direct a survey crew gathering topographic data using controlling point methods. Work will proceed smoothly and be complete within the time limit set by the instructor. Ninety percent (90%) of all data will conform to normal topographic accuracy.

SECTION IV

CURRICULUM STRUCTURE, EXIT POINTS & COURSE OUTLINE

SECTION IV

Section IV Content List

Introduction to the Curriculum Structure
Curriculum Structure
  Group
  Individualized
Introduction to Civil Technology - Surveying Exit Points
Introduction to the Course Outline
Course Outline

Section III presented a sample organizational model for sequencing the instruction of program tasks. Based on that model, Section IV provides suggested methods of structuring the entire Civil Technology - Surveying curriculum.

INTRODUCTION TO THE CURRICULUM STRUCTURE

A curriculum structure is developed by sequencing duties into a logical teaching plan. Two curriculum structures are presented in this section - group and individualized.

The individualized structure also lists the duty areas, but does not include hours or quarters. Using the individualized approach, the student proceeds at his or her pace until each task is mastered.

In either type of structure, the duty areas can be rearranged to meet local needs.

CIVIL TECHNOLOGY - SURVEYING
SUGGESTED CURRICULUM STRUCTURE*

Course	Class Hours	Lab Hours	Total Hours
Quarter I			
Basic Surveying Procedures	60	108	168
Measuring Distance	36	108	144
	96	216	312
Quarter II			
Measuring Elevation	24	36	60
Measuring Angles	12	30	42
Traversing	20	52	72
Surveying Mathematics	138	0	138
	194	118	312
Quarter III			
Basic Drafting Procedures	26	52	78
Route Drafting	12	48	60
Mapping	12	42	54
Platting	12	108	120
	62	250	312
Quarter IV			
Boundary Surveys	59	49	108
Route Surveys	51	39	90
Construction Surveys	6	54	60
Topographic Surveys	12	42	54
	128	184	312
Total Program Hours	480	768	1248

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*This curriculum structure is designed to be used for group instruction.

CIVIL TECHNOLOGY - SURVEYING
SUGGESTED CURRICULUM STRUCTURE*

Orientation
  School Policies and Procedures
  Program Orientation and Safety
  Operation of Audiovisual Equipment (optional)
  Using the Learning Resource Center

Basic Surveying Procedures

Measuring Distance

Measuring Elevation

Measuring Angles

Traversing

Surveying Mathematics

Basic Drafting Procedures

Route Drafting

Mapping

Platting

Boundary Surveys

Route Surveys

Construction Surveys

Topographic Surveys

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*This curriculum structure is designed to be used for individualized instruction.

INTRODUCTION TO CIVIL TECHNOLOGY - SURVEYING
EXIT POINTS

The following diagrams illustrate points in the Civil Technology - Surveying program where a student should have acquired competencies necessary for entry level employment.

Both the group and individualized exit point diagrams sequence the Civil Technology - Surveying job classifications from least to most difficult. The group exit point diagram illustrates a lock-step process in which students proceed through an entire program at the same pace and exit at approximately the same point in time.

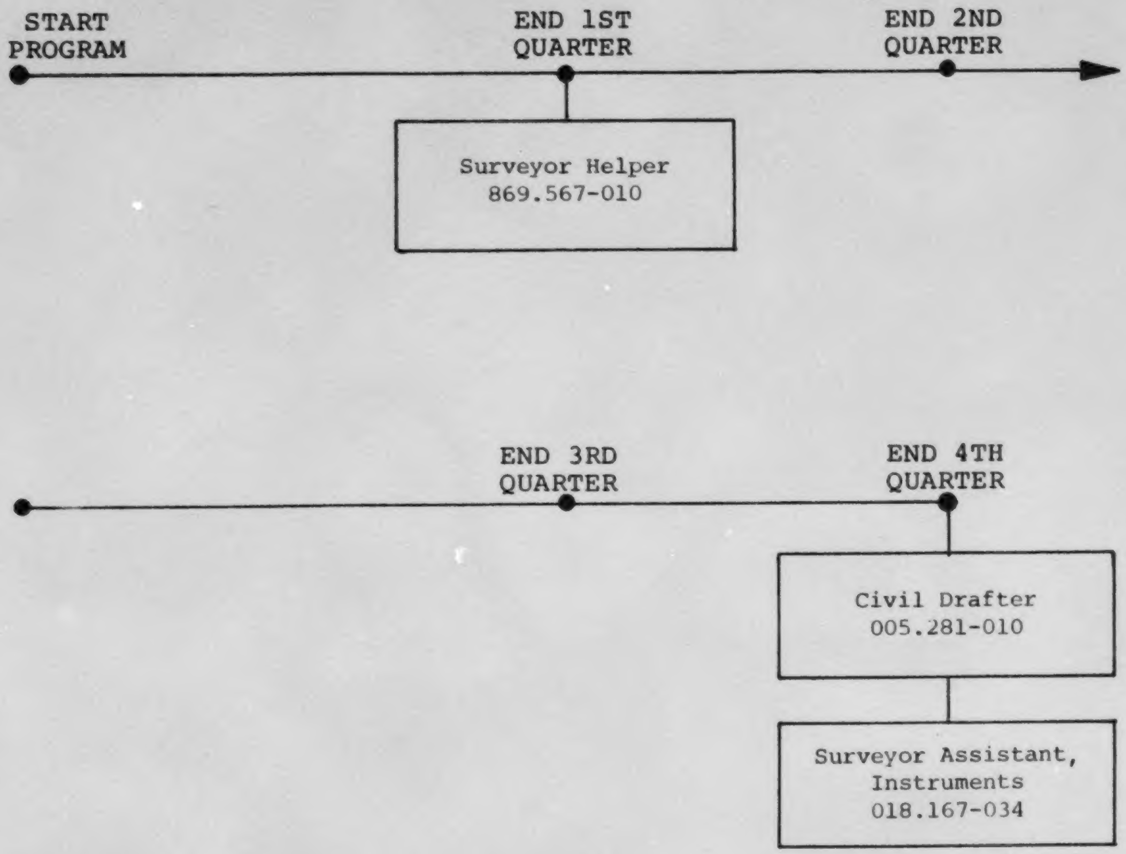
The individualized exit point diagram illustrates a self-paced progression through the Civil Technology - Surveying program. This approach permits a student to complete any one or all tasks necessary for entry level employment.

The major difference between the group and individualized approach is the number of tasks a student must master. For example, in the individualized approach, a student desiring employment as a civil drafter needs to complete only those tasks identified for that job. However, in the group approach, a student must master the tasks in the previous DOT classifications leading to that particular job title.

Both diagrams are based on the preceeding suggested curriculum structures.

CIVIL TECHNOLOGY - SURVEYING

(Group Instruction)


START PROGRAM
END 1ST QUARTER
END 2ND QUARTER
Surveyor Helper 869.567-010
END 3RD QUARTER
END 4TH QUARTER
Civil Drafter 005.281-010
Surveyor Assistant, Instruments 018.167-034

CIVIL TECHNOLOGY - SURVEYING

(Individualized Instruction)

Surveyor Helper
869.567-010

Civil Drafter
005.281-010

Surveyor Assistant,
Instruments
018.167-034

INTRODUCTION TO THE COURSE OUTLINE

A course outline suggests a method of sequencing tasks for instruction. In the following outline, the unit guide tasks are ordered according to duty areas. The tasks are then arranged from general to specific knowledge and applications. The instructor is not restricted to using this specific outline, but may adapt it to meet his or her teaching needs.

The following course outline is designed for group instruction, however, it may be adapted for individualized instruction by eliminating the time sequencing for tasks.

CIVIL TECHNOLOGY - SURVEYING
SUGGESTED COURSE OUTLINE

Quarter I

Task	Title	Class Hours	Lab Hours
	DUTY I: BASIC SURVEYING PROCEDURES		
BSP-01	Understanding surveying careers	9	0
BSP-02	Maintaining general survey notes	3	6
BSP-03	Performing safely while surveying	9	0
BSP-04	Pacing for distance measurement	3	6
BSP-05	Determining direction with the hand compass	3	6
BSP-06	Traversing by compass-pacing methods	6	12
BSP-07	Using surveying hand signals	3	6
BSP-08	Clearing line and bush	6	18
BSP-09	Giving line	6	18
BSP-10	Using targets for line	6	18
BSP-11	Using the Philadelphia rod	6	18
		60	108
	DUTY II: MEASURING DISTANCE		
MD-01	Performing rear chaining - horizontal	6	18
MD-02	Performing head chaining - horizontal	6	18
MD-03	Maintaining chaining notes - horizontal	6	18
MD-04	Performing rear chaining - slope	6	18
MD-05	Performing head chaining - slope	6	18
MD-06	Maintaining chaining notes - slope	6	18
		36	108
	Total Quarter I Class and Lab Hours	96	216
	Total Quarter I Instructional Hours	312	

Quarter II

Task	Title	Class Hours	Lab Hours
	DUTY III: MEASURING ELEVATION		
ME-01	Understanding general leveling	6	0
ME-02	Maintaining notes for level runs	6	18
ME-03	Understanding leveling field procedures	6	0
ME-04	Using the dumpy level	6	18
		24	36
	DUTY IV: MEASURING ANGLES		
MA-01	Using the standard one-minute transit	2	4
MA-02	Using the standard 30 second transit	2	4
MA-03	Using the standard 20 second transit	2	4
MA-04	Using the theodolite	6	18
		12	30
	DUTY V: TRAVERSING		
TR-01	Traversing with the standard transit and chain	6	18
TR-02	Maintaining notes for transit traverses	6	18
TR-03	Setting points on line	2	4
TR-04	Bucking in on line	2	4
TR-05	Prolonging a line	2	4
TR-06	Deflecting around an object	2	4
		20	52
	DUTY VI: SURVEYING MATHEMATICS		
SM-01	Understanding rounding and significant digits	6	0
SM-02	Understanding surveying errors and precision	6	0
SM-03	Performing angle computations	6	0
SM-04	Computing traverse directions	6	0
SM-05	Performing right triangle computations	6	0
SM-06	Correcting distance measurements	6	0
SM-07	Computing latitudes and departures	6	0
SM-08	Balancing a closed traverse	6	0
SM-09	Computing area of a closed traverse	6	0
SM-10	Computing coordinates of a traverse	6	0
SM-11	Computing closed traverses	24	0
SM-12	Inversing between coordinates	6	0
SM-13	Computing distance-distance intersections	12	0
SM-14	Computing distance-bearing intersections	12	0
SM-15	Computing bearing-bearing intersections	12	0
SM-16	Using a programmable calculator	12	0
		138	0

Total Quarter II Class and Lab Hours	194		118
Total Quarter II Instructional Hours		312	

Quarter III

Task	Title	Class Hours	Lab Hours
	DUTY VII: BASIC DRAFTING PROCEDURES		
BDP-01	Understanding drafting terminology and symbols	6	0
BDP-02	Using drafting instruments	2	4
BDP-03	Lettering on engineering drawings	2	16
BDP-04	Performing linework	2	16
BDP-05	Using a civil engineering scale	4	8
BDP-06	Recognizing drafting media	6	0
BDP-07	Performing print duplication	4	8
		26	52
	DUTY VIII: ROUTE DRAFTING		
RD-01	Drafting preliminary profiles	4	16
RD-02	Drafting preliminary cross sections	4	16
RD-03	Drafting final construction drawings	4	16
		12	48
	DUTY IX: MAPPING		
MP-01	Plotting field data	4	14
MP-02	Interpreting and plotting contours	4	14
MP-03	Using topographic symbols and conventions	4	14
		12	42
	DUTY X: PLATTING		
PL-01	Drafting land plats	6	54
PL-02	Drafting subdivision plats	6	54
		12	108
	Total Quarter III Class and Lab Hours	62	250

Total Quarter III Instructional Hours 312

Quarter IV

Task	Title	Class Hours	Lab Hours
	DUTY XI: BOUNDARY SURVEYS		
BS-01	Understanding boundary definitions and terminology	6	0
BS-02	Understanding the historical perspective of land surveying	6	0
BS-03	Understanding the legal basis of land surveying	6	0
BS-04	Identifying evidence	6	0
BS-05	Determining senior evidence	6	0
BS-06	Conducting legal research - tax office	3	9
BS-07	Conducting legal research - superior court record room	3	9
BS-08	Conducting legal research - archives	3	9
BS-09	Understanding field procedures for boundary surveys	2	10
BS-10	Subdividing land	6	12
BS-11	Writing legal descriptions	12	0
		59	49
	DUTY XII: ROUTE SURVEYS		
RS-01	Understanding route surveying definitions and terminology	6	0
RS-02	Calculating horizontal curves	9	0
RS-03	Calculating stakeout data of horizontal curves	9	0
RS-04	Calculating vertical curves	9	0
RS-05	Calculating stakeout data of vertical curves	9	0
RS-06	Planning and designing route surveys	6	0
RS-07	Computing earthwork quantities	3	9
RS-08	Staking out horizontal curves	0	10
RS-09	Staking out vertical curves	0	10
RS-10	Staking out highway slopes	0	10
		51	39
	DUTY XIII: CONSTRUCTION SURVEYS		
CS-01	Conducting a reconnaissance survey	1	9
CS-02	Conducting a preliminary survey	1	9
CS-03	Conducting a location survey	1	9
CS-04	Conducting a pipeline survey	1	9
CS-05	Setting building batter boards	1	9
CS-06	Performing subdivision construction staking	1	9
		6	54
	DUTY XIV: TOPOGRAPHIC SURVEYS		
TS-01	Understanding topographic definitions and terminology	6	0

Task	Title	Class Hours	Lab Hours
TS-02	Using a planetable and alidade	2	10
TS-03	Using stadia for distance and elevation	2	10
TS-04	Field mapping using a grid system	1	11
TS-05	Field mapping using controlling points	1	11
		12	42

Total Quarter IV Class and Lab Hours 128 184
Total Quarter IV Instructional Hours 312

Total Program Instructional Hours 1248

SECTION V

RECORDS

SECTION V

Section V Content List

Individualized Competency Record
Group Progress Chart

Section V presents suggested ways of recording and documenting the progress of students through the curriculum. The recommended procedures include options for both individual and group records. The very important function of communicating the student's qualifications to potential employers is handled clearly and efficiently by the use of the Certificate of Competency, which is also described in this section.

RECORDS MANAGEMENT

This guide provides a series of easy to use documents that will aid the instructor in recordkeeping and that will be beneficial to the student in entering the work force.

In addition to providing the instructor with an "at a glance" assessment of individual and/or group progress, a Certificate of Competency, which can be used by students seeking employment, is included.

The group progress chart reflects individual task completion of all students. Due to confidentiality of records, grades must not be recorded on the chart. A notation indicating task completion (i.e., x or check) should be used.

INSTRUCTIONS

Instructions

Competency Checklist

1) Enter the student's name.
2) Enter the date and instructor's initials as each unit of instruction is completed.

The Competency Checklist automatically indicates when all the requirements for each DOT exit point or job title have been completed by the student. At each point on the certificate where an asterisk appears, the student is eligible to receive a Certificate of Competency.

Certificate of Competency

A Certificate of Competency is to be issued for each job title for which a student is qualified.

1) Enter the student's name.
2) Enter the school's name
3) Sign and date the form.

A Certificate of Competency may be issued at the time a student qualifies for it, or all certificates for which a student qualifies may be issued to the student when he/she completes or leaves the program.

Group Progress Chart

1) Enter all program tasks across top of matrix.
2) Enter the students' names down the left hand side of matrix.
3) As each student completes a task, a notation should be made in the square which corresponds with the task and the student's name.

COMPETENCY CHECKLIST

PROGRAM: CIVIL TECHNOLOGY - SURVEYING

STUDENT NAME: ______________________________

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	EXIT POINTS JOB TITLE Surveyor Helper DOT NO. 869.567-010	Civil Drafter 005.281-010	Surveyor Assistant 018.167-034
	Basic Surveying Procedures					
BSP-01	Understanding surveying careers			X	X	X
BSP-02	Maintaining general survey notes			X	X	X
BSP-03	Performing safely while surveying			X		X
BSP-04	Pacing for distance measurement			X		X
BSP-05	Determining direction with the hand compass			X		X
BSP-06	Traversing by compass-pacing methods			X		X
BSP-07	Using surveying hand signals			X		X
BSP-08	Clearing line and bush			X		X
BSP-09	Giving line			X		X
BSP-10	Using targets for line			X		X
BSP-11	Using the Philadelphia rod			X		X
	Measuring Distance					
MD-01	Performing rear chaining - horizontal			X		X
MD-02	Performing head chaining - horizontal			X		X
MD-03	Maintaining chaining notes - horizontal			X	X	X
MD-04	Performing rear chaining - slope			X		X
MD-05	Performing head chaining - slope			X		X
MD-06	Maintaining chaining notes - slope			*X	X	X
	Measuring Elevation					
MD-01	Understanding general leveling				X	X
MD-02	Maintaining notes for level runs				X	X
MD-03	Understanding leveling field procedures				X	X
MD-04	Using the dumpy level					X
	Measuring Angles					
MA-01	Using the standard one-minute transit					X
MA-02	Using the standard 30-second transit					X
MA-03	Using the standard 20-second transit					X
MA-04	Using the theodolite					X
	Traversing					
TR-01	Traversing with the standard transit and chain					X
TR-02	Maintaining notes for transit traverses				X	X
TR-03	Setting points on line					X
TR-04	Bucking in on line					X
TR-05	Prolonging a line					X
TR-06	Deflecting around an object					X
	Surveying Mathematics					
SM-01	Understanding rounding and significant digits				X	X
SM-02	Understanding surveying errors and precision				X	X
SM-03	Performing angle computations				X	X
SM-04	Computing traverse directions				X	X
SM-05	Performing right triangle computations				X	X
SM-06	Correcting distance measurements				X	X
SM-07	Computing latitudes and departures				X	X
SM-08	Balancing a closed traverse				X	X
SM-09	Computing area of a closed traverse				X	X
SM-10	Computing coordinates of a traverse				X	X
SM-11	Computing closed traverses				X	X
SM-12	Inversing between coordinates				X	X
SM-13	Computing distance-distance intersections				X	X
SM-14	Computing distance-bearing intersections				X	X

COMPETENCY CHECKLIST

PROGRAM: CIVIL TECHNOLOGY - SURVEYING

STUDENT NAME: ______________________________

EXIT POINTS

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	JOB TITLE: Surveyor Helper DOT NO.: 869.567-010	Civil Drafter 005.281-010	Surveyor Assistant 018.167-034
SM-15	Computing bearing-bearing intersections				X	X
SM-16	Using a programmable calculator				X	X
	Basic Drafting Procedures					
BDP-01	Understanding drafting terminology and symbols				X	
BDP-02	Using drafting instruments				X	
BDP-03	Lettering on engineering drawings				X	
BDP-04	Performing linework				X	
BDP-05	Using a civil engineering scale				X	
BDP-06	Recognizing drafting media				X	
BDP-07	Performing print duplication				X	
	Route Drafting					
RD-01	Drafting preliminary profiles				X	
RD-02	Drafting preliminary cross sections				X	
RD-03	Drafting final construction drawings				X	
	Mapping					
MP-01	Plotting field data				X	
MP-02	Interpreting and plotting contours				X	
MP-03	Using topographic symbols and conventions				X	
	Platting					
PL-01	Drafting land plats				X	
PL-02	Drafting subdivision plats				X	
	Boundary Surveys					
BS-01	Understanding boundary definitions and terminology					X
BS-02	Understanding the historical perspective of land surveying					X
BS-03	Understanding the legal basis of land surveying					X
BS-04	Identifying evidence					
BS-05	Determining senior evidence					X
BS-06	Conducting legal research - tax office					X
BS-07	Conducting legal research - superior court record room					X
BS-08	Conducting legal research - archives					
BS-09	Understanding field procedures for boundary surveys					X
BS-10	Subdividing land					X
BS-11	Writing legal descriptions					X
	Route Surveys					
RS-01	Understanding route surveying definitions and terminology					X
RS-02	Calculating horizontal curves					X
RS-03	Calculating stakeout data of horizontal curves					X
RS-04	Calculating vertical curves					X
RS-05	Calculating stakeout data of vertical curves					X
RS-06	Planning and designing route surveys					X
RS-07	Computing earthwork quantities					X
RS-08	Staking out horizontal curves					X
RS-09	Staking out vertical curves					X
RS-10	Staking out highway slopes					X
	Construction Surveys					
CS-01	Conducting a reconnaissance survey					X
CS-02	Conducting a preliminary survey					X
CS-03	Conducting a location survey					X

COMPETENCY CHECKLIST

EXIT POINTS

PROGRAM: CIVIL TECHNOLOGY - SURVEYING

STUDENT NAME:________________________________

TASK NO.	UNIT COMPETENCIES	DATE	IN'T.	DOT NO. 869.567-010 JOB TITLE Surveyor Helper	005.281-010 Civil Drafter	018.167-034 Surveyor Assistant
CS-04	Conducting a pipeline survey					X
CS-05	Setting building batter boards					X
CS-06	Performing subdivision construction staking					X
	Topographic Surveys					
TS-01	Understanding topographic definitions and terminology					X
TS-02	Using a plane table and alidade					X
TS-03	Using stadia for distance and elevation					X
TS-04	Field mapping using a grid system					X
TS-05	Field mapping using controlling points					*X

This is to certify that the above named student has demonstrated proficiency in the performance of the competencies and/or tasks indicated above. These competencies and/or tasks have been determined to be the skills and knowledge that are necessary for entry level employment into the job classifications indicated.

Date__________________ Instructor______________________________

School______________________________

Instructor______________________________

Instructor______________________________

Instructor______________________________

Instructor______________________________

*Certificate of Competency can be issued

CERTIFICATE OF COMPETENCY

This is to Certify that

Carl A. Wright

SAMPLE

DeKalb Area Vocational Technical School

has successfully mastered the competencies required to perform the job of

SURVEYOR ASSISTANT

Stephen M. Mills

October 15, 1981

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Surveyor Assistant.

SURVEYOR ASSISTANT
(D.O.T. Code 018.167-034)

Basic Surveying Procedures
Understanding surveying careers
Maintaining general survey notes
Performing safely while surveying
Pacing for distance measurement
Determining direction with the hand compass
Traversing by compass-pacing methods
Using surveying hand signals
Clearing line and bush
Giving line
Using targets for line
Using the Philadelphia rod

Measuring Distance
Performing rear chaining - horizontal
Performing head chaining - horizontal
Maintaining chaining notes - horizontal
Performing rear chaining - slope
Performing head chaining - slope
Maintaining chaining notes - slope

Measuring Elevation
Understanding general leveling
Maintaining notes for level runs
Understanding leveling field procedures
Using the dumpy level

Measuring Angles
Using the standard one-minute transit
Using the standard 30-second transit
Using the standard 20-second transit
Using the theodolite

Traversing
Traversing with the standard transit and chain
Maintaining notes for transit traverses
Setting points on line
Bucking in on line
Prolonging a line
Deflecting around an object

Surveying Mathematics
Understanding rounding and significant digits
Understanding surveying errors and precision
Performing angle computations
Computing traverse directions
Performing right triangle computations
Correcting distance measurements
Computing latitudes and departures
Balancing a closed traverse
Computing area of a closed traverse
Computing coordinates of a traverse
Computing closed traverses
Inversing between coodinates
Computing distance-distance intersections
Computing distance-bearing intersections
Computing bearing-bearing intersections
Using a programmable calculator

Boundary Surveys
Understanding boundary definitions and terminology
Understanding the historical perspective of land surveying
Understanding the legal basis of land surveying
Identifying evidence
Determining senior evidence
Conducting legal research - tax office
Conducting legal research - superior court record room
Conducting legal research - archives
Understanding field procedures for boundary surveys
Subdividing land
Writing legal descriptions

Route Surveys
Understanding route surveying definitions and terminology
Calculating horizontal curves
Calculating stakeout data of horizontal curves
Calculating vertical curves
Calculating stakeout data of vertical curves
Planning and designing route surveys
Computing earthwork quantities
Staking out horizontal curves
Staking out vertical curves
Staking out highway slopes

Construction Surveys
Conducting a reconnaissance survey
Conducting a preliminary survey
Conducting a location survey
Conducting a pipeline survey
Setting building batter boards
Performing subdivision construction staking

Topographic Surveys
Understanding topographic definitions and terminology
Using a plane table and alidade
Using stadia for distance and elevation
Field mapping using a grid system
Field mapping using controlling points

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

SURVEYOR HELPER
____

____

____

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Surveyor Helper.

SURVEYOR HELPER
(D.O.T. Code 869.567-010)

Basic Surveying Procedures

- Understanding surveying careers
- Maintaining general survey notes
- Performing safely while surveying
- Pacing for distance measurement
- Determining direction with the hand compass
- Traversing by compass-pacing methods
- Using surveying hand signals
- Clearing line and bush
- Giving line
- Using targets for line
- Using the Philadelphia rod

Measuring Distance

- Performing rear chaining - horizontal
- Performing head chaining - horizontal
- Maintaining chaining notes - horizontal
- Performing rear chaining - slope
- Performing head chaining - slope
- Maintaining chaining notes - slope

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

CIVIL DRAFTER
____

____

____

V-15

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Civil Drafter.

CIVIL DRAFTER
(D.O.T. Code 005.281-010)

Basic Surveying Procedures
Understanding surveying careers
Maintaining general survey notes

Measuring Distance
Maintaining chaining notes - horizontal
Maintaining chaining notes - slope

Measuring Elevation
Understanding general leveling
Maintaining notes for level runs
Understanding leveling field procedures

Traversing
Maintaining notes for transit traverses

Surveying Mathematics
Understanding rounding and significant digits
Understanding surveying errors and precision
Performing angle computations
Computing traverse directions
Performing right triangle computations
Correcting distance measurements
Computing latitudes and departures
Balancing a closed traverse
Computing area of a closed traverse
Computing coordinates of a traverse
Computing closed traverses
Inversing between coordinates
Computing distance-distance intersections
Computing distance-bearing intersections
Computing bearing-bearing intersections
Using a programmable calculator

Basic Drafting Procedures
Understanding drafting terminology and symbols
Using drafting instruments
Lettering on engineering drawings
Performing linework
Using a civil engineering scale
Recognizing drafting media
Performing print duplication

Route Drafting
Drafting preliminary profiles
Drafting preliminary cross sections
Drafting final construction drawings

Mapping
Plotting field data
Interpreting and plotting contours
Using topographic symbols and conventions

Platting
Drafting land plats
Drafting subdivision plats

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

SURVEYOR ASSISTANT

____

____

The student named on this certificate has demonstrated mastery of the following unit level competencies required to perform the job of Surveyor Assistant.

SURVEYOR ASSISTANT
(D.O.T. Code 018.167-034)

Basic Surveying Procedures
- Understanding surveying careers
- Maintaining general survey notes
- Performing safely while surveying
- Pacing for distance measurement
- Determining direction with the hand compass
- Traversing by compass-pacing methods
- Using surveying hand signals
- Clearing line and bush
- Giving line
- Using targets for line
- Using the Philadelphia rod

Measuring Distance
- Performing rear chaining - horizontal
- Performing head chaining - horizontal
- Maintaining chaining notes - horizontal
- Performing rear chaining - slope
- Performing head chaining - slope
- Maintaining chaining notes - slope

Measuring Elevation
- Understanding general leveling
- Maintaining notes for level runs
- Understanding leveling field procedures
- Using the dumpy level

Measuring Angles
- Using the standard one-minute transit
- Using the standard 30-second transit
- Using the standard 20-second transit
- Using the theodolite

Traversing
- Traversing with the standard transit and chain
- Maintaining notes for transit traverses
- Setting points on line
- Bucking in on line
- Prolonging a line
- Deflecting around an object

Surveying Mathematics
- Understanding rounding and significant digits
- Understanding surveying errors and precision
- Performing angle computations
- Computing traverse directions
- Performing right triangle computations
- Correcting distance measurements
- Computing latitudes and departures
- Balancing a closed traverse
- Computing area of a closed traverse
- Computing coordinates of a traverse
- Computing closed traverses
- Inversing between coodinates
- Computing distance-distance intersections
- Computing distance-bearing intersections
- Computing bearing-bearing intersections
- Using a programmable calculator

Boundary Surveys
- Understanding boundary definitions and terminology
- Understanding the historical perspective of land surveying
- Understanding the legal basis of land surveying
- Identifying evidence
- Determining senior evidence
- Conducting legal research - tax office
- Conducting legal research - superior court record room
- Conducting legal research - archives
- Understanding field procedures for boundary surveys
- Subdividing land
- Writing legal descriptions

Route Surveys
- Understanding route surveying definitions and terminology
- Calculating horizontal curves
- Calculating stakeout data of horizontal curves
- Calculating vertical curves
- Calculating stakeout data of vertical curves
- Planning and designing route surveys
- Computing earthwork quantities
- Staking out horizontal curves
- Staking out vertical curves
- Staking out highway slopes

Construction Surveys
- Conducting a reconnaissance survey
- Conducting a preliminary survey
- Conducting a location survey
- Conducting a pipeline survey
- Setting building batter boards
- Performing subdivision construction staking

Topographic Surveys
- Understanding topographic definitions and terminology
- Using a plane table and alidade
- Using stadia for distance and elevation
- Field mapping using a grid system
- Field mapping using controlling points

GROUP PROGRESS CHART

NAME	UNITS/TASKS																				

SECTION VI

FACILITIES

SECTION VI

Section VI Content List

Group Instruction Facilities
Individualized Instruction Facilities

The facility layouts on the following pages are presented to aid in arranging the classroom and laboratory for efficient instruction. The school administration and program instructor must determine an arrangement that best fits the needs of the students by determining the most efficient use of resources available to them not only in the laboratory, but also in the Learning Resource Center settings.

FACILITY LAYOUTS

The layouts on the following pages illustrate how facilities for group and individualized instructional programs may be planned and set up.

Each instructional approach has two important physical areas. These are (1) the laboratory (work) area and classroom for group instruction and (2) the laboratory (work) area and learning resource center (LRC) for individualized instruction.

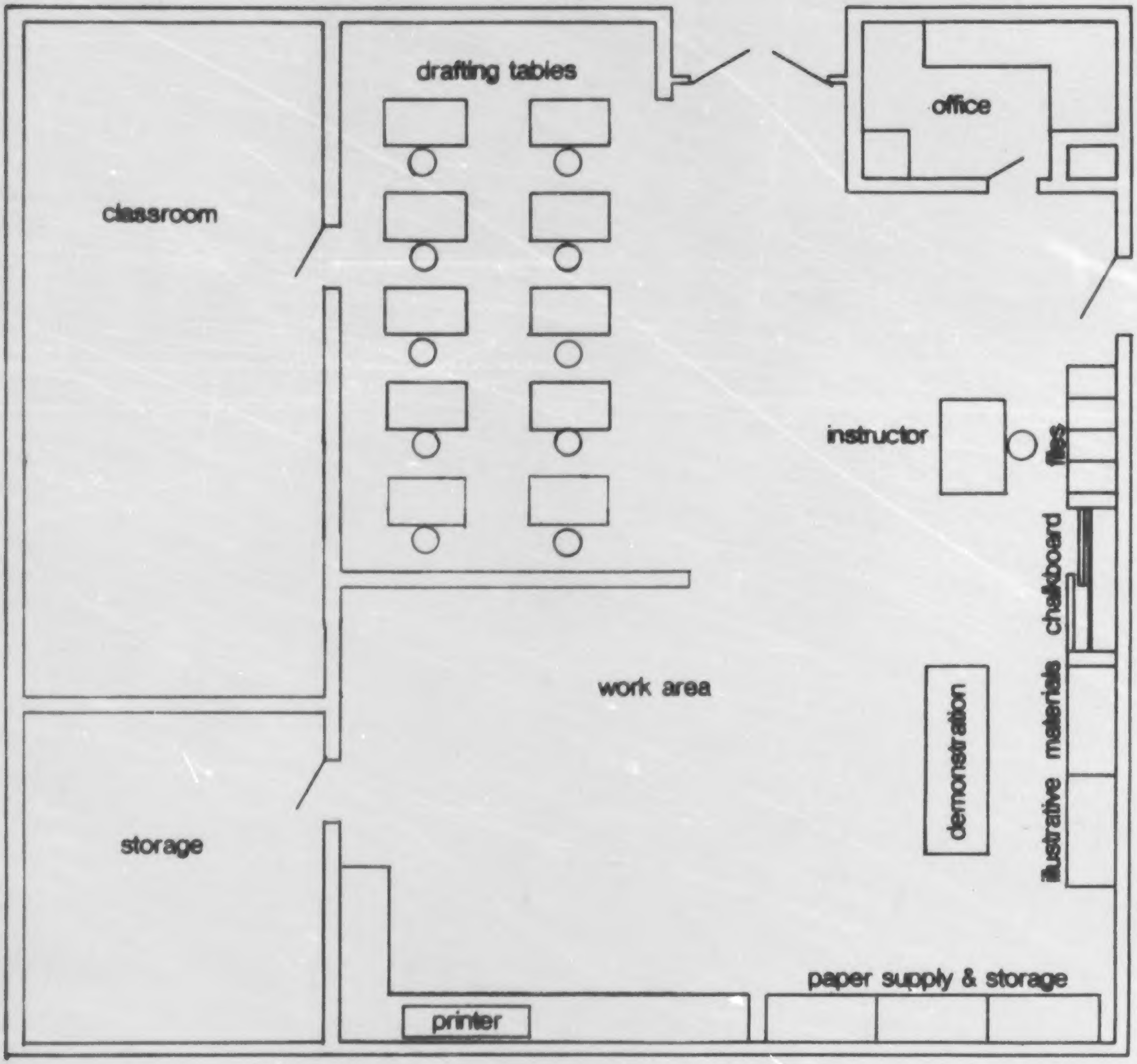
The instructional setting for group instruction is based on that of a traditional classroom. This approach is easily set up and includes little or no modifications. The primary modes of learning are instructor lectures, occasional use of audiovisual aids and student participation. Ideally, all students progress at the same pace.

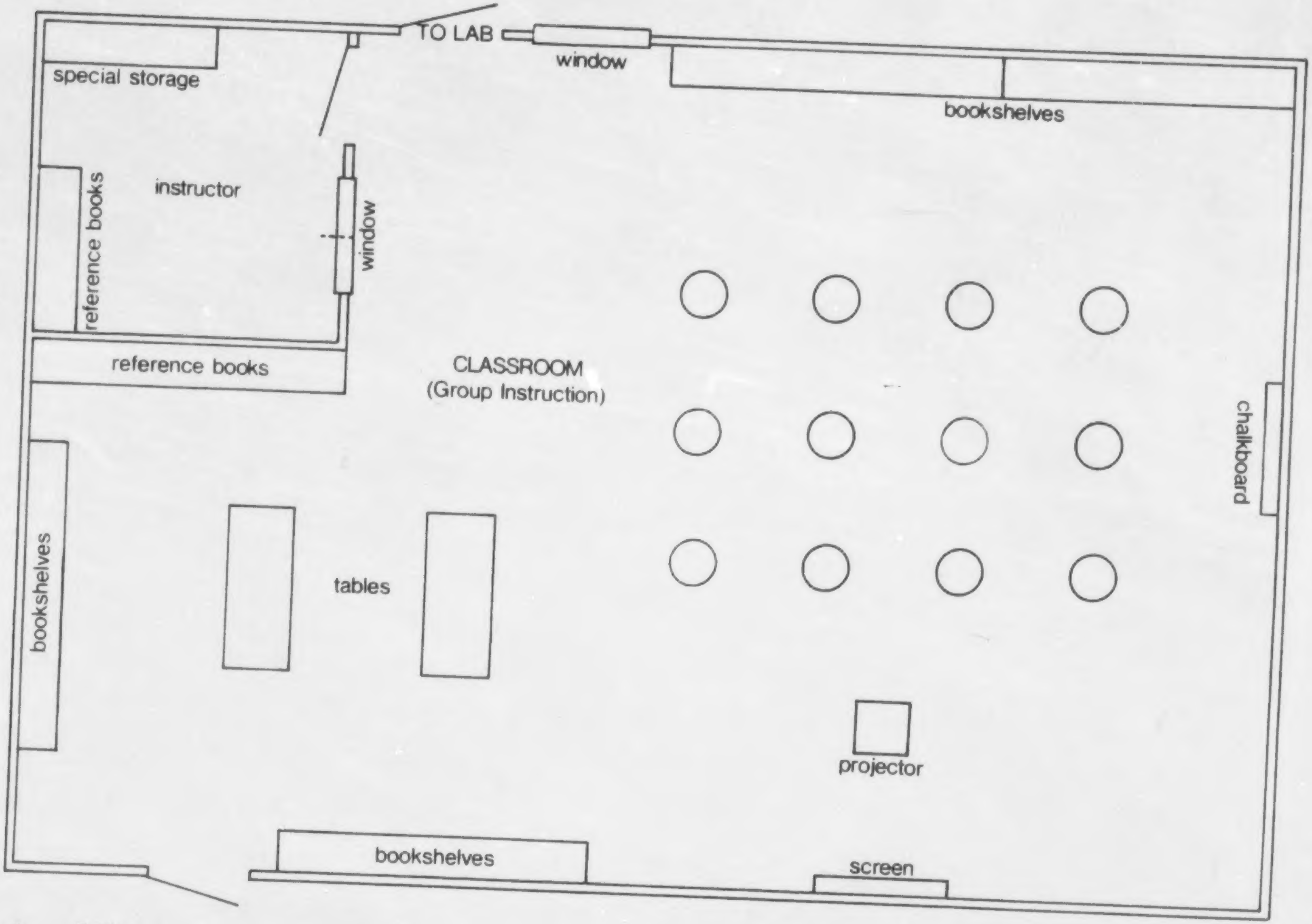
The instructional setting for individual instruction is designed to facilitate a student self-paced progression of learning. The LRC requires careful planning in utilizing available space. When planning to install an individual instruction program in an area not originally designed for this approach, the instructional setting may need modifications. Desks may be replaced with study carrels to allow students to simultaneously participate in a variety of learning activities. A group session area for small group gatherings should also be included. Because the instructor and students rarely meet together as a group, a bulletin board becomes a vital communication device in an LRC. It can be used to post announcements and such instructional information as group progress charts, assignments, positions available in the industry and safety rules.

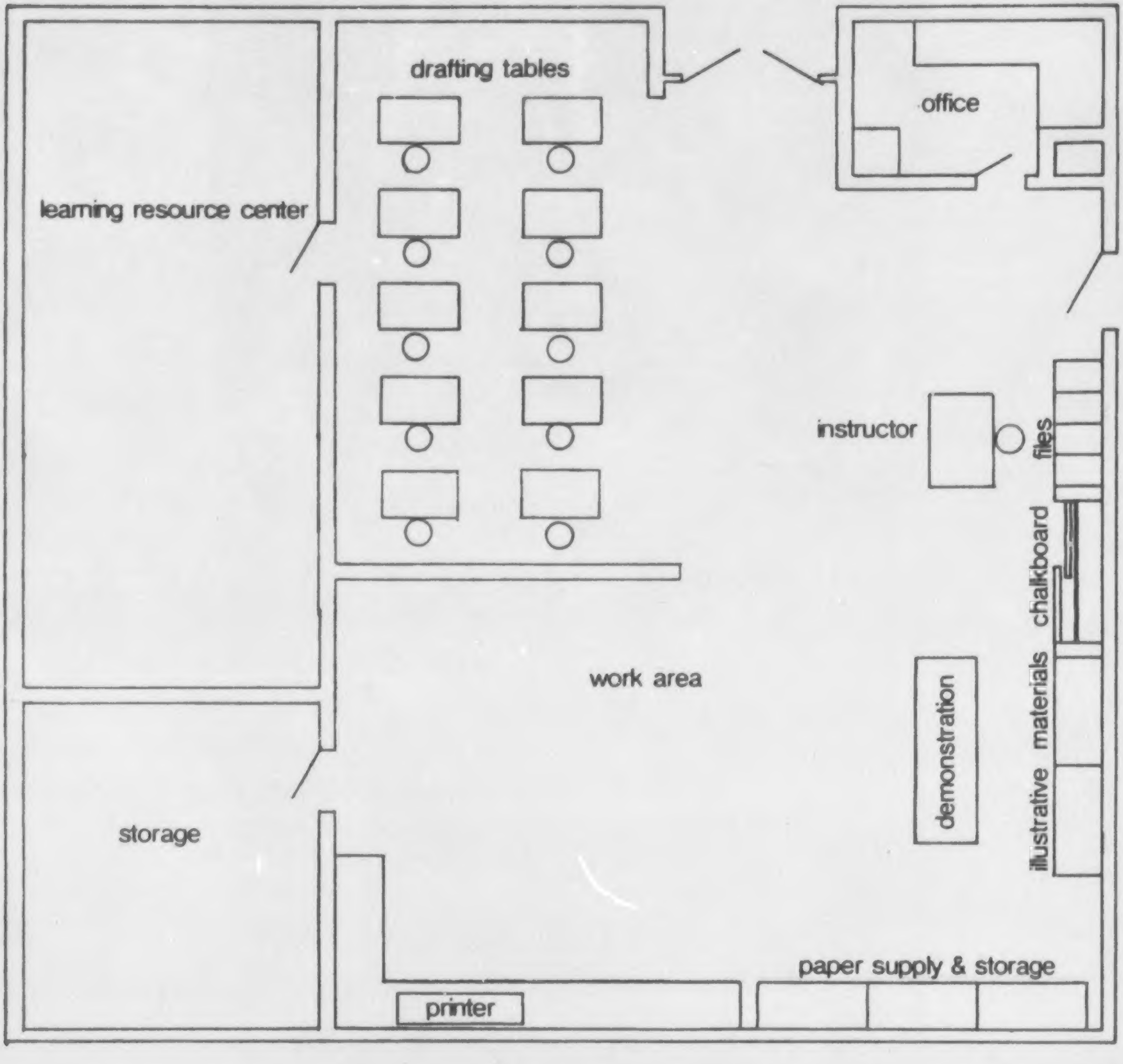
A variety of references, resources and media equipment should be made available to the student. Therefore, an adequate amount of storage area should be included in planning the LRC. Every specific school and department has unique physical layout characteristics and problems. Through innovation, these features may be transformed into LRC advantages rather than disadvantages.

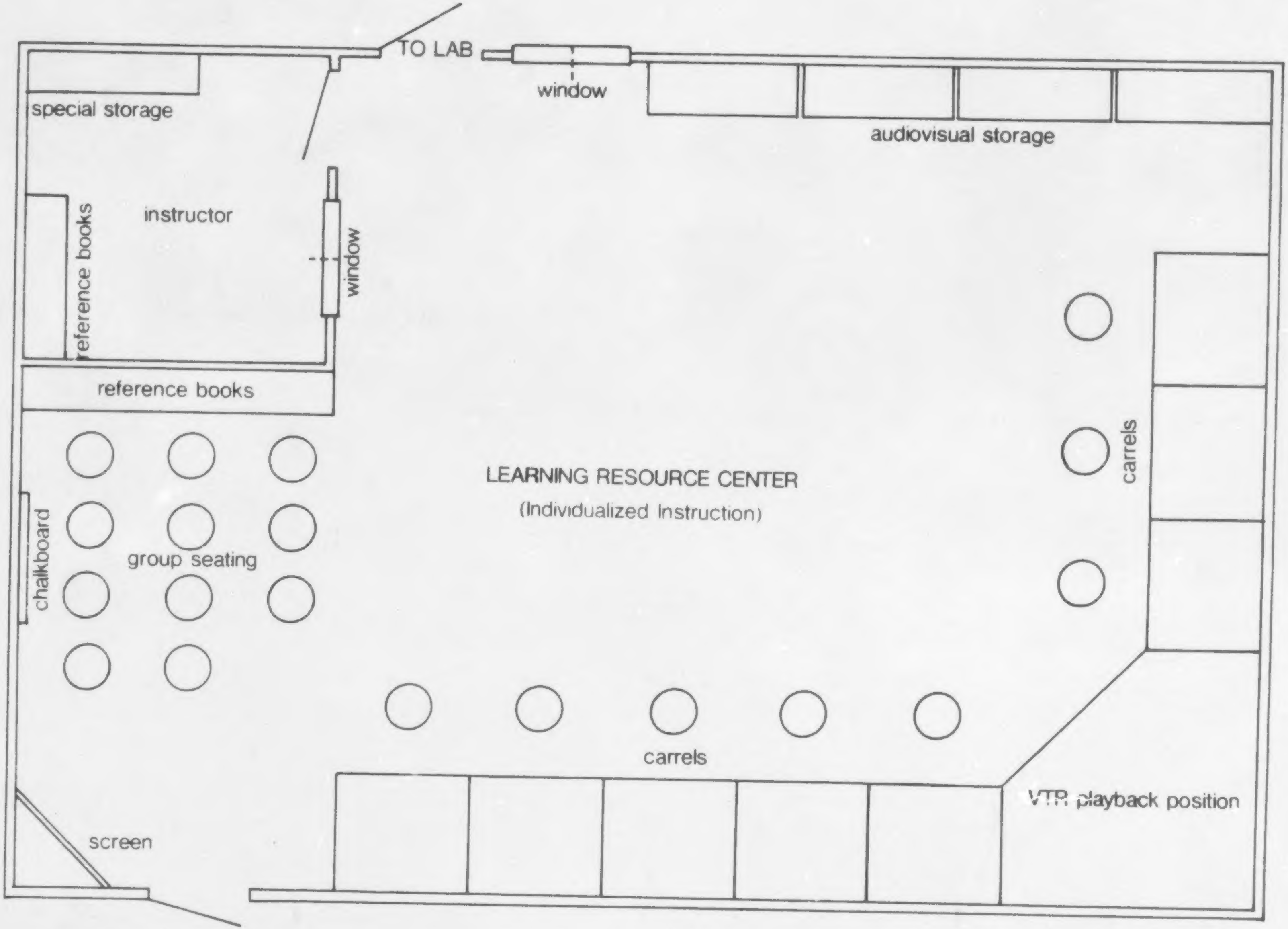
The manner in which the laboratory (work) area is planned and set up need not be affected by the type of instructional approach used by an instructor; it could/will be the same. Some major concerns in the laboratory are: 1) the instructor must always have a clear line of sight to each and every workstation, 2) tools must be accessible to students, but under the control of the instructor and 3) all supplies and materials required for the day's activities must be on hand and ready to use.

The laboratory (work) area facility suggested here has been intentionally left spacious to accommodate the instructor in demonstrations and student practice of tasks such as pacing, target use, using the transit and level rod, setting points on line, etc.


drafting tables
office
classroom
instructor
files
chalkboard
work area
demonstration
illustrative materials
storage
paper supply & storage
printer


TO LAB
window
special storage
bookshelves
instructor
reference books
window
reference books
CLASSROOM
(Group Instruction)
chalkboard
bookshelves
tables
projector
bookshelves
screen


drafting tables
office
learning resource center
instructor
files
chalkboard
work area
demonstration
illustrative materials
storage
paper supply & storage
printer


TO LAB
window
special storage
audiovisual storage
instructor
reference books
window
reference books
LEARNING RESOURCE CENTER
(Individualized Instruction)
carrels
chalkboard
group seating
carrels
VTR playback position
screen

APPENDIX A

Resources

RESOURCES

This appendix contains the instructional resource matrix, unit guide reference and additional instructional materials.

The instructional resource matrix lists the textbooks for each task referenced on the unit guide sheets.

The unit guide bibliography lists textbooks cited in the unit guides section.

The additional instructional materials is a compilation of textbooks not included in the unit guides but beneficial to educators.

Resources addresses for all references concludes this appendix.

CURRICULUM AREA: CIVIL TECHNOLOGY - SURVEYING

TASK LISTING		TEXTBOOKS
BSP-01	Understanding surveying careers	Brinker: Elementary Surveying; Davis, Foote and Kelly: Survey: Theory and Practice; McCormac: Surveying; Pafford: Handbook of Surveying Notekeeping
BSP-02	Maintaining general surveying notes	McCormac: Surveying; Pafford: Handbook of Survey Notekeeping
BSP-03	Performing safely while surveying	American Red Cross: Multi-Media Standard First Aid; American Red Cross: Standard First Aid and Personal Safety
BSP-04	Pacing for distance measurement	Brinker: Elementary Surveying; McCormac: Surveying
BSP-05	Determining direction with the hand compass	Brinker: Elementary Surveying; McCormac: Surveying
BSP-06	Traversing by compass-pacing methods	Brinker: Elementary Surveying; McCormac: Surveying
BSP-07	Using surveying hand signals	McCormac: Surveying; Pafford: Handbook of Surveying Notekeeping
BSP-08	Clearing line and bush	Various tool manufacturer's maintenance manuals
BSP-09	Giving line	Brinker: Elementary Surveying; McCormac: Surveying
BSP-10	Using targets for line	Brinker: Elementary Surveying; McCormac: Surveying
BSP-11	Using the Philadelphia rod	Brinker: Elementary Surveying; McCormac: Surveying
MD-01	Performing rear chaining-horizontal	McCormac: Surveying
MD-02	Performing head chaining-horizontal	McCormac: Surveying
MD-03	Maintaining chaining notes-horizontal	Pafford: Handbook of Survey Notekeeping; McCormac: Surveying
MD-04	Performing rear chaining-slope	McCormac: Surveying

CURRICULUM AREA: CIVIL TECHNOLOGY - SURVEYING

TASK LISTING		TEXTBOOKS
MD-05	Performing head chaining-slope	McCormac: Surveying
MD-06	Maintaining chaining notes-slope	McCormac: Surveying
ME-01	Understanding general leveling	Brinker: Elementary Surveying; McCormac: Surveying
ME-02	Maintaining notes for level runs	Brinker: Elementary Surveying; McCormac: Surveying
ME-03	Understanding leveling field procedures	Brinker: Elementary Surveying; McCormac: Surveying
ME-04	Using the dumpy level	Brinker: Elementary Surveying; McCormac: Surveying
MA-01	Using the standard one-minute transit	Brinker: Elementary Surveying; McCormac: Surveying
MA-02	Using a standard 30-second transit	Brinker: Elementary Surveying; McCormac: Surveying
MA-03	Using the standard 20-second transit	Brinker: Elementary Surveying; McCormac: Surveying
MA-04	Using the theodolite	Brinker: Elementary Surveying; Kissam: Surveying for Civil Engineers
TR-01	Traversing with the standard transit and chain	Brinker: Elementary Surveying; McCormac: Surveying
TR-02	Maintaining notes for transit	McCormac: Surveying; Pafford: Handbook of Survey Notekeeping
TR-03	Setting points on line	McCormac: Surveying
TR-04	Bucking in on line	McCormac: Surveying
TR-05	Prolonging a line	McCormac: Surveying
TR-06	Deflecting around an object	Davis, Foote and Kelly: Survey: Theory and Practice
SM-01	Understanding rounding and significant digits	McCormac: Surveying

CURRICULUM AREA: CIVIL TECHNOLOGY - SURVEYING

TASK LISTING	TEXTBOOKS
SM-02 Understanding surveying errors and precision	Brinker: Elementary Surveying; McCormac: Surveying
SM-03 Performing angle computations	Herubin: Principles of Surveying; McCormac: Surveying
SM-04 Computing traverse directions	Brinker: Elementary Surveying; McCormac: Surveying
SM-05 Performing right triangle computations	Any shop math textbook
SM-06 Correcting distance measurements	Brinker: Elementary Surveying; McCormac: Surveying
SM-07 Computing latitudes and departures	Brinker: Elementary Surveying; McCormac: Surveying
SM-08 Balancing a closed traverse	Brinker: Elementary Surveying; McCormac: Surveying
SM-09 Computing the area of a closed traverse	Brinker: Elementary Surveying; McCormac: Surveying
SM-10 Computing coordinates of a traverse	Brinker: Elementary Surveying; McCormac: Surveying
SM-11 Computing closed traverses	Brinker: Elementary Surveying; McCormac: Surveying
SM-12 Inversing between coordinates	Brinker: Elementary Surveying
SM-13 Computing distance-distance intersections	Davis, Foote and Kelly: Survey: Theory and Practice
SM-14 Computing distance-bearing intersections	Davis, Foote and Kelly: Survey: Theory and Practice
SM-15 Computing bearing-bearing intersections	Davis, Foote and Kelly: Survey: Theory and Practice
SM-16 Using a programmable calculator	Owner's manual for specific calculator
BDP-01 Understanding drafting definitions, symbols and terminology	Luzadder: Fundamentals of Engineering Drawing

CURRICULUM AREA: CIVIL TECHNOLOGY - SURVEYING

TASK LISTING		TEXTBOOKS
BDP-02	Using drafting instruments	Luzadder: Fundamentals of Engineering Drawing
BDP-03	Lettering on engineering drawings	Luzadder: Fundamentals of Engineering Drawing
BDP-04	Performing linework	Luzadder: Fundamentals of Engineering Drawing
BDP-05	Using a civil engineering scale	Luzadder: Fundamentals of Engineering Drawing
BDP-06	Recognizing drafting media	Luzadder: Fundamentals of Engineering Drawing
BDP-07	Performing print duplication	Luzadder: Fundamentals of Engineering Drawing; Operating manual for specific machine
RD-01	Drafting preliminary profiles	Davis, Foote and Kelly: Survey: Theory and Practice
RD-02	Drafting preliminary cross-sections	Davis, Foote and Kelly: Survey: Theory and Practice
RD-03	Drafting final construction drawings	Davis, Foote and Kelly: Survey: Theory and Practice
MP-01	Plotting field data	Brinker: Elementary Surveying; Luzadder: Fundamentals of Engineering Drawing
MP-02	Interpreting and plotting contours	Brinker: Elementary Surveying; Luzadder: Fundamentals of Engineering Drawing; McCormac: Surveying
MP-03	Using topographic symbols and conventions	Brinker: Elementary Surveying; Luzadder: Fundamentals of Engineering Drawing; McCormac: Surveying
PL-01	Drafting land plats	Brinker: Elementary Surveying; Luzadder: Fundamentals of Engineering Drawing; McCormac: Surveying
PL-02	Drafting subdivision plats	Brinker: Elementary Surveying; Luzadder: Fundamentals of Engineering Drawing; McCormac: Surveying

CURRICULUM AREA: CIVIL TECHNOLOGY - SURVEYING

TASK LISTING		TEXTBOOKS
BS-01	Understanding boundary definitions and terminology	Brown: Boundary Control and Legal Principles; Brown: Evidence and Procedures for Boundary Location; McCormac: Surveying
BS-02	Understanding the historical perspective of land surveying	Brown: Evidence and Procedures for Boundary Location; McCormac: Surveying
BS-03	Understanding the legal basis of land surveying	Brown: Boundary Control and Legal Principles; Brown: Evidence and Procedures for Boundary Location; McCormac: Surveying
BS-04	Identifying evidence	Brown: Evidence and Procedures for Boundary Location
BS-05	Determining senior evidence	Brown: Boundary Control and Legal Principles; Brown: Evidence and Procedures for Boundary Location
BS-06	Conducting legal research - tax office	
BS-07	Conducting legal research - superior court record room	
BS-08	Conducting legal research - archives	
BS-09	Understanding field procedures for boundary surveys	Brown: Evidence and Procedures for Boundary Location
BS-10	Subdividing land	
BS-11	Writing legal descriptions	Brown: Boundary Control and Legal Principles; Brown: Evidence and Procedures for Boundary Location
RS-01	Understanding route surveying definitions and terminology	Brinker: Elementary Surveying; Hickerson: Route Location and Design; McCormac: Surveying
RS-02	Calculating horizontal curves	Brinker: Elementary Surveying; Hickerson: Route Location and Design; McCormac: Surveying

CURRICULUM AREA: CIVIL TECHNOLOGY - SURVEYING

TASK LISTING		TEXTBOOKS
RS-03	Calculating stakeout data for horizontal surveys	Brinker: Elementary Surveying; Hickerson: Route Location and Design; McCormac: Surveying
RS-04	Calculating vertical curves	Brinker: Elementary Surveying; Hickerson: Route Location and Design; McCormac: Surveying
RS-05	Calculating stakeout data for vertical curves	Brinker: Elementary Surveying; Hickerson: Route Location and Design; McCormac: Surveying
RS-06	Planning and designing route surveys	Brinker: Elementary Surveying; Hickerson: Route Location and Design; McCormac: Surveying
RS-07	Computing earthwork quantities	Brinker: Elementary Surveying; McCormac: Surveying
RS-08	Staking out horizontal curves	Brinker: Elementary Surveying; Hickerson: Route Location and Design; McCormac: Surveying
RS-09	Staking out vertical curves	Brinker: Elementary Surveying; Hickerson: Route Location and Design; McCormac: Surveying
RS-10	Staking out highway slopes	
CS-01	Conducting a reconnaissance survey	Hickerson: Route Location and Design
CS-02	Conducting a preliminary survey	Hickerson: Route Location and Design
CS-03	Conducting a location survey	Hickerson: Route Location and Design
CS-04	Conducting a pipeline survey	Brinker: Elementary Surveying; McCormac: Surveying
CS-05	Setting building batter boards	Brinker: Elementary Surveying; McCormac: Surveying
CS-06	Performing subdivision construction staking	Brinker: Elementary Surveying; McCormac: Surveying

CURRICULUM AREA: CIVIL TECHNOLOGY - SURVEYING

TASK LISTING	TEXTBOOKS
TS-01 Understanding topographic definitions and terminology	Brinker: Elementary Surveying; McCormac: Surveying
TS-02 Using a planetable and alidade	Brinker: Elementary Surveying; McCormac: Surveying
TS-03 Using stadia for distance and elevation	Brinker: Elementary Surveying; McCormac: Surveying
TS-04 Field mapping using a grid system	Brinker: Elementary Surveying; McCormac: Surveying
TS-05 Field mapping using controlling points	Brinker: Elementary Surveying; McCormac: Surveying

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Siegle, Arthur, Basic Plane Surveying. Albany, NY: Delmar Publishers, 1979.

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RESOURCE ADDRESSES

American Red Cross
(Contact your local
organization.)

Beekman Publisher, Inc.
38 Hicks Street
Brooklyn Heights, NY 11201

CARBEN Surveying Reprints
10324 Newton Way
Rancho Conlova, CA 95670

Delmar Publishers
50 Wolf Road Albany, NY
Albany, NY 12205

Frederick Ungar Publishing
Company, Inc.
250 Park Avenue South
New York, NY 10003

Harper and Row Publishers, Inc.
E. 53rd Street
New York, NY 10022

John Wiley and Sons, Inc.
605 Third Avenue
New York, NY 10158

McClain Printing Company
212 Main Street
Parsons, WV 26287

McGraw-Hill Book Company
Princeton Road
Hightstown, NJ 08520

Prentice-Hall, Inc.
Englewood Cliffs, NY 07632

Renouf USA, Inc.
Brookfield, VT 05036

Reston Publishing Company
11480 Sunset Hills Road
Reston, VA 22090

Syracuse University Press
1011 E. Water Street
Syracuse, NY 13210

Thomas Y. Crowell Company
10 E. 53rd Street
New York, NY 10022

Walter DeGruyter, Inc.
200 Saw Mill River Road
Hawthorne, NY 10532

APPENDIX B

Special Needs

WORKING WITH SPECIAL NEEDS STUDENTS*

Introduction

Special needs population students are those who are designated as handicapped or disadvantaged. The 1976 vocational education amendments define handicapped individuals as:

> Persons who are mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, health impaired, or persons with other specific disabilities, who by reason thereof require special education and related services and who cannot succeed in the regular vocational education programs.

In those same amendments disadvantaged persons are defined as:

> Persons (other than handicapped persons) who have academic or economic disadvantages and who require special services, assistance or programs in order to enable them to succeed in vocational education programs.

Federal legislation requires that these special needs population students be given an opportunity to function in regular vocational education programs (Essentially, this is what is meant by the term mainstreaming.). This section provides information on how such students are identified and how they can be mainstreamed into regular vocational education environments.

Figure One presents a conceptual model depicting various activities of the process in identifying and mainstreaming special needs students in vocational education. These activities

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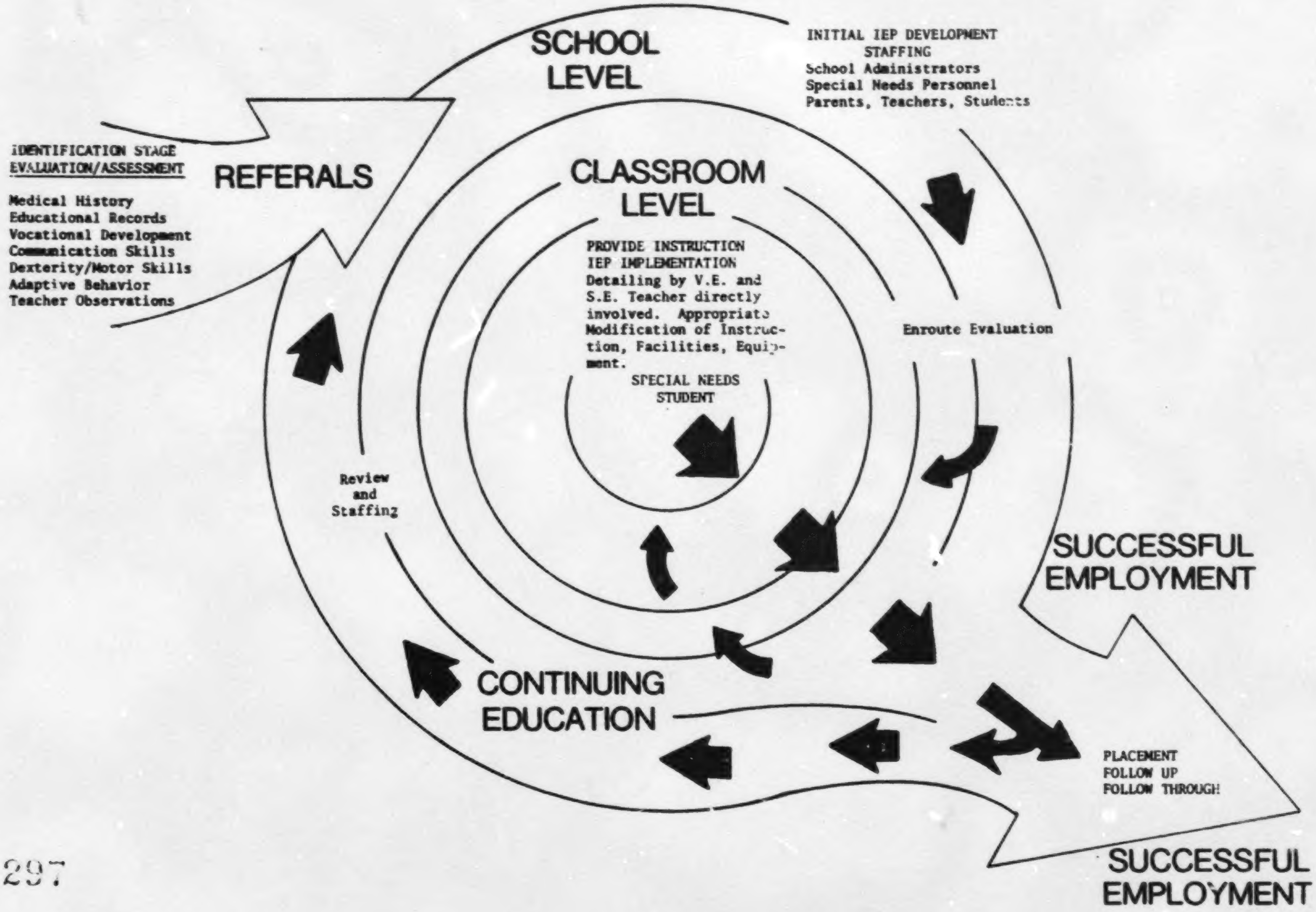
THE CONCEPT OF MAINSTREAMING


SCHOOL LEVEL
INITIAL IEP DEVELOPMENT
STAFFING
School Administrators
Special Needs Personnel
Parents, Teachers, Students
IDENTIFICATION STAGE
EVALUATION/ASSESSMENT
Medical History
Educational Records
Vocational Development
Communication Skills
Dexterity/Motor Skills
Adaptive Behavior
Teacher Observations
REFERALS
CLASSROOM LEVEL
PROVIDE INSTRUCTION
IEP IMPLEMENTATION
Detailing by V.E. and S.E. Teacher directly involved. Appropriate Modification of Instruction, Facilities, Equipment.
SPECIAL NEEDS STUDENT
Enroute Evaluation
Review and Staffing
SUCCESSFUL EMPLOYMENT
CONTINUING EDUCATION
PLACEMENT
FOLLOW UP
FOLLOW THROUGH
SUCCESSFUL EMPLOYMENT

are conducted at three levels: the community level, the school level (Career Development Center) and the classroom level. All three levels must work together if implementation of the process is to be effective.

Identification of the Special Needs Student

Through a variety of pre-testing procedures, special needs students are identified and their potentials are evaluated at the community level. This evaluation process consists of collecting and assessing the following data for each student:

- Medical History
- Educational Records
- Vocational Development
- Communication Skills
- Dexterity/Motor Skills
- Adaptive Behavior
- Teacher Observations

When this procedure has been completed, the community personnel refers the student to the appropriate school level personnel. As a part of the referral and school intake process, an Individualized Educational Plan should be initiated.

> The Individualized Educational Plan (IEP) is exactly what its name implies--a plan for the education of a specific individual. The base content of the IEP is outlined in Public Law 94-142. According to that outline, the IEP must include at least the following information: (a) student's present level of functioning, (b) his/her long range instructional objectives, (c) his/her short-range instructional objectives and finally, (d) some criteria to determine that those objectives have been achieved.

Development of the Individual Education Plan

It would be very difficult to anticipate the exact kind or type of special needs students one might find in an Civil Technology - Surveying program at any one time. The terms disadvantaged and handicapped are really "catch-all" terms that indicate a wide assortment of problems that might occur a in student representing one of these populations. In addition to the lack of a specific definition and the fact that the typical vocational instructor has had very little preparation in working with these students, it becomes clear that you will need a basic plan to use in meeting their occupational preparation needs. The following steps can serve as your basic planning procedure for mainstreaming a special needs population student into your curriculum.

The first step occurs after you have been notified that a special needs student can profit from being in your vocational program. When you have received that notification, you should contact your coordinator of student personnel services and ask for a detailed report of the student's assessed status. Note the word assessed; it is critical. Through a formal assessment status, appropriate school personnel and community should have identified the student's strengths and weaknesses as well as the specific handicapping conditions. After you have received the assessment information and understand it you are ready for Step Two.

Step Two, developing (or completing) the vocational aspects of the Individual Education Plan-IEP, is usually performed for handicapped students only; however, it has just as much merit for the disadvantaged. The IEP is a very useful tool. It should be considered the description of what you expect that student to be able to do when he or she completes your course and how you will provide the learning experiences to assure that those expected outcomes will be achieved. Be sure that you keep this IEP in a convenient place and use it.

The IEP is usually developed through group activities called staffings. Staffings may be held as often as needed and can be used to modify the IEP as the student moves through the program. When a student is about to be mainstreamed into your curriculum, you must become involved in the staffing sessions that will develop the vocational aspects of the IEP. IT IS YOUR RIGHT AND YOUR DUTY, therefore, your being present during the staffings is imperative. The special education personnel can present the student's interests, strengths and limitations. However, only you, the vocational instructor, can relate these to your program. This means that the final statement of the job (DOT) and the task level (short term) objectives are primarily defined by you the vocational instructor.

In Step Three the IEP will first be used to suggest how the curriculum and/or the facilities can be modified to accommodate the special needs population student. Modifying the curriculum means that in most cases special adjustments will have to be made in the student materials and that special instructional strategies will need to be developed. When you say modify the curriculum you are not suggesting that the content be "watered down" - you are proposing alternate ways to teach the proper/required content. REMEMBER! ALL VOCATIONAL EDUCATION PROGRAMS ARE BASED ON REAL JOBS THAT HAVE THEIR OWN TASKS AND STANDARDS. AS FAR AS YOU ARE CONCERNED, YOU HAVE NO POWER TO CHANGE THESE. YOU ALSO CANNOT SUCCESSFULLY CREATE A WHOLE NEW JOB.

Modification of facilities and equipment is a concern when working with the phyically handicapped. Be reminded that by law your school building must already meet requirements of accessibility to all handicapped persons--especially those who are blind or are confined to wheelchairs. Your chief concern is to be sure that your classroom and laboratory will allow the handicapped students to be comfortable and above all to learn. You will also need to make certain modifications that will enable handicapped students to properly and safely use the "tools and equipment of the trade". It is foolish to think that you would have a ready answer for all or any particular one of these physical handicaps--call on the experts. Vocational rehabilitation counselors and other staff have been concentrating on these problems for many years. They should be able to offer a number of positive suggestions. A combination of VR experience and instructor creativity can and has produced outstanding results.

As we think about curriculum modification it would help to review some general learning needs of this population.

> The educationally mentally retarded will constitute a major population now entering vocational education. The key concept to remember in modifying the curriculum for this population is that they require much more detail in order to learn and they require a great deal more practice time. All curriculum modifications for these groups should be made by detailing each task or objective into its smallest parts and by providing for more and more practice.
>
> The hearing and visually impaired can be accommodated by common sense and the use of supporting resource personnel. Neither of these groups reads well or learns from reading as a primary mode. This should be accounted for in modifying the curriculum, i.e., larger print, brail and recordings for the blind and captions on visual materials, seating arrangements, use of notes from a classmate, lower reading level textbooks, oral testing and total communications for the deaf.

The orthopedically handicapped usually require attention to facilities and equipment. Beyond that, their learning needs are as varied as those of the normal population. Remember, some of these individuals will actually be highly gifted in their chosen field. Their major needs will be psychological and coping with the school environment.

The disadvantaged are physically and mentally capable of learning, but their background has not allowed them to fully develop the discipline and cognitive skills (i.e., vocabulary, math, etc.) required to master occupational preparation courses. They have also developed an anti-school attitude that complicate many efforts to modify the curriculum for them. Usually their success in the vocational program is contingent on either a good pre-vocational program or a supporting academic program.

Step Four requires that instructional strategies be selected. These strategies may be many and should be varied. They should reflect the best learning technique for a given student and his or her chosen occupation. Some examples of instructional strategies are discussed below.

Teacher demonstration: Simply show the student how the job is to be done in clear distinct steps.

Peer demonstration: This technique allows the instructor to use one of the advanced students to demonstrate a particular task in a step by step fashion. It is a flexible system. For example, you can use peer demonstration to show each task step while you explain them to the students. When working with the mentally retarded, you will never have enough time to demonstrate a task as often as they may need to see it. In such situations, the well prepared advanced student can perform and explain the same demonstration several times.

Shadowing: Shadowing can be used in conjunction with demonstrations. By shadowing, the student is allowed to do exactly what the demonstrator does. This allows the student to learn in a see and do fashion. The student may shadow the instructor, an advanced peer or in some instances the worker on the job.

Job site visits: Job site visits offer the student an opportunity to see the work being done in its natural location. Students can develop a worker identify a realistic view of how the tools, equipment and materials are brought together to produce the product.

Work group or team: By being a part of a work team, the student can learn the various roles in an occupation as having the opportunity to practice specific sets of skills under the tutelage of peers.

Individualized instruction: Appropriately prepared or adjusted individualized instruction is a big help in managing a class that contains a mixture of special needs population students and "norm group" students. Individualized instruction, no matter what the source, will require much developmental input from the instructor. In most all cases, however, the results are worth the effort.

Media: Many of the special needs populations require mediated instruction (i.e., hearing and visually impaired), however, the use of appropriate media enhances learning for all students. Media can range from a line drawing in an instructional module, to a video tape, to posters and charts. It can be instructor made or commercial. All that matters is that it exactly links to the objective.

Project Method: The value in using projects with special needs population students is that they help them mentally and physically unify all the parts into a uniform whole. Because of the detail required for them to learn, they need learning activities that relate all of the parts to the whole. The development of a product through an assigned project is an ideal integrating experience.

Simulations: Simulations meet a variety of instructional needs. One of the more important with special needs population students is providing the opportunity to develop proper safety concepts before actually working with the "live" equipment that could be dangerous to a careless student.

Role playing: Role playing is a part of several other instructional strategies. On its own, it is a very good procedure for developing the attitudes and values required of a successful worker-i.e., a sense of responsibility, the ability to take orders and follow directions, interpersonal skills and so on. It is a way to concentrate on developing good work habits and positive attitudes.

Peer instruction: Like peer demonstrations, peer instruction is able to multiply the instructor's available time. This allows individual students with specific needs to have more assistance. Peer instruction has values beyond expanding time; it is an excellent approach to learning. In almost every situation, both the peer teacher and the peer student profit from the exchange. In operation peer instruction is simply a matter of preparing and allowing one of the advanced students to teach small groups certain segments of a course.

Team teaching: As we have already noted, some special needs populations require a combination of vocational and special education presented in harmony. A team approach is the only way to meet that need. For team teaching to be effective, clarification of student needs (as defined by the IEP) and careful planning will be required.

Peer apprenticeships: The peer apprenticeship is an ideal way to induct the new special needs population student into the curriculum. By serving as the apprentice to an advanced student, the special needs population student can become climatized to the laboratory/shop and can begin to learn the tools, equipment and materials of the program. The shadow technique can also be added to increase hands-on learning.

Assessment and feedback: Student learning can be improved by frequently assessing students' skills and feeding back their strengths and weaknesses. Through a process of positive feedback, the student can be moved gradually from where he or she is to the level of skill required.

These instructional strategies can be used independently or in various combinations. This brief list is meant only to provide you with some suggestions, there are no doubt many other techniques that could be used. The creative instructor will be constantly innovating to meet the needs of particular students.

Implementing the IEP

Step Five is a matter of putting the vocational aspects of the IEP into operation. The activation of the IEP initiates the student into the vocational education program and allows him or her to progress through the modified curriculum at his or her optium rate. There should be frequent assessment activities that indicate where the student is relative to the IEP objectives. If problems are detected, a staffing should be conducted to re-evaluate the IEP and continue the process in a fashion that is most beneficial to the student.

Step Six will take the student to his or her next logical step of either totally exiting the system or recycling into a continuing education mode. In most cases, the student will do some of both--getting a job and periodically accessing the continuing education component of the educational system to refine existing skills or to broaden his or her capacity.

The ultimate goal of all this effort is not employment- rather it is "successful employment". Successful employment implies that not only is the student placed in a job, but that the student is able to sustain himself or herself in a working environment over an extended period of time.

Evaluation

Evaluation of the student's program is a critical step. Through that process we not only help the current student, but we are able to gather information that will improve our potential to help students with similar difficulties in the future. A well rounded evaluation system should consist of the following activities:

- En-route evaluation (formative) to monitor the student's progress through the program.
- Summative evaluation upon completion of the program to determine job readiness.
- Follow-up after placement to determine if the student is successful on the job.
- Follow-through activities designed to identify any further training needed, which may be indicated by the follow-up procedure.

RESOURCES

In recent years, mainstreaming of special needs population students has been an area of great concern to vocational educators. The overall result of that concern is an abundance of well developed resource materials and a variety of personnel with special skills in working with these groups. In the space allowed by this curriculum guide, it would be impossible to present an adequate set of methods and procedures for solving the problems of students with special needs, but if the vocational eduction administrator and instructor will judiciously use the human and material resources listed here, much of the in-depth information required for the special and unique cases that will occur can be compiled from these sources.

Support Personnel or Systems

As was noted earlier, you the vocational instructor, simply do not have sufficient skills to work with special needs population students alone. There are too many different student problems to ever allow an instructor to deal with them all on a "come as you are" basis. For that reason, you must make yourself aware of the variety of support systems and personnel that are available to you and to the students. A few of these are listed here. These specialists can lead you to others on an as needed basis.

County Health Department - Many of your special needs population students will need some medical and dental assistance. The county health facility is an excellent referral source for these problems.

Special Education - Through local boards of education there are a variety of special education personnel available locally, regionally and from the State Department of Education. The vocational education administrator can obtain assistance from these specialists through the local superintendent's office.

Project SERVE - Project SERVE is a statewide effort to acquire materials and to cultivate expertise in providing vocational education to disadvantaged. Project Serve can be contacted by the area vocational-technical director or the vocational supervisor.

Vocational Rehabilitation - Vocational rehabilitation is a highly developed organization whose major focus is all dimensions (such as: diagnosing, training, job placement and counseling) of the handicapped population. Within that network is a vast pool of expertise. You can contact it through the area vocational rehabilitation counselor who calls on your school or through a designated school official such as the coordinator of student personnel services or Career Development Center personnel.

Office of Student Personnel Services - In the area vocational-technical school, this is the key group as far as students and student needs are concerned. They can provide a variety of services to you and to your students. Many of the contacts with community agencies have already been made by this group-that alone will save the instructor much time.

Career Development Center - Each area vocational-technical school has a Career Development Center designed to meet the very special needs of incoming disadvantaged and handicapped students. The CDC staff is available to assist the instructional staff with a wide range of services for the special needs student populations.

All of the resources and resource personnel listed here are a part of the team. The best results can be obtained by using as many of these people and their support systems as possible from the beginning. In some situations, you will miss a resource in the beginning or the student's needs change. When that occurs do not hesitate to call on the appropriate experts for additional help. As a matter of fact, the rule of thumb that has always been used in the "helping professions" is to go as far as you can, then refer. Do not hesitate to call for help. Most of these service groups are funded to support "your" student. If you do not use them, they fail in their mission and you fail in yours.

Related Materials

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APPENDIX C

Definition of Terms

DEFINITION OF TERMS

1. A/Vs-Audiovisuals - May refer to any picture and/or sound media. (ie. slides, tapes, filmstrips, 16 mm films, etc.)

2. Checkpoint - A student-instructor interface point wherein the instructor may give the student a test, perform a demonstration, or simply provide the student with additional needed information or instructions. Also a checkpoint may be used for motivational purposes.

3. Competency - The ability (knowledge, skills and attitudes) to perform all of a group or cluster of related tasks required to complete a designated activity according to occupational standards. In the educational setting, the statement of a competency includes expected student outcomes in terms of knowledge, skills and attitudes required to complete a designated activity as defined by incumbent workers according to the standards of the work place.

4. Course - A grouping of tasks and competencies which have a common knowledge base or are within a given domain.

5. Criterion-Referenced Measure - An exercise based upon a performance objective, the accomplishment of which measures attainment of that objective.

6. Criterion-Referenced Test - A test designed to measure student competencies based on job or industrial standards.

7. Curriculum Guide - A document containing the objectives, content, organization and structure of an instructional program. It is designed for use by administrators, instructional supervisors and teachers.

8. D.O.T. - Abbreviation for Dictionary of Occupational Titles. Document provides nine digit codes identifying each occupation.

9. Duty - One of the distinct major activities involved in the work performed. A Composition of related tasks.

10. Exit Point - A pre-determined point within an instructional program in which a student may exit with the essential competencies for a specific job. Usually defined in terms of D.O.T. codes and/or O.E. codes.

11. "Hands-On" - Statement implying the student is physically involved in a learning activity.

12. Individualized Instruction (I.I.) - A system of instruction allowing a student to progress at his/her fastest rate.

13. Job - A specific area of specialization within an occupational field consisting of several closely related duties for which a person would expect to receive remuneration. Should be identified by DOT code.

14. Job Sheet - (Or Operations Sheet) - A project of a performance nature. Generally performed by the student in a lab or shop type environment or in a specialized work area.

15. Live Work - Generally refers to items brought into the course area for repair or adjustment. Examples of live work might be automobiles, radios and TV's, air-conditioners, etc. Another form of live work would be patrons visiting the cosmetology department to receive permanents or other services.

16. Master Copies - Original copies of slides, tapes or written materials set aside for the purpose of duplication.

17. Occupational Cluster - A group of occupations sharing a common core of competencies. Georgia's comprehensive high school vocational program is organized around this concept.

18. Occupational Inventory - A listing of tasks to be performed in a particular occupational area, grouped under duty classifications.

19. O.E. - Refers to the U.S. Office of Education. O.E. codes are a classification system (taxonomy) for occupational education programs.

20. Open Entry - Term meaning that a student may enter the program at any time and does not have to wait for quarter or semester breaks.

21. Open Exit - Term meaning that a student may leave a program any time he/she completes occupational objectives.

22. Performance Guide - A series of steps arranged in a sequence which when completed may result in the performance of a task. Also called teaching steps.

23. Performance Objective - A statement in precise, measurable terms of a particular behavior to be exhibited by a learner underspecified conditions. It possesses each of the elements or characteristics specified below:

    a. Condition - The testing situation confronting the learner is clearly specified. This includes equipment provided or withheld, environmental constraints such as temperature, space, etc.

   b. Performance - The specific behavior expected of the learner is stated.

   c. Standard - The degree of acceptable performance is specified.

24. Performance Test - A test entailing not only the ability to answer questions, but measuring the student ability to operate, manipulate or perform a given task.

25. Program - An organized sequence of courses leading to an occupational objective. A program may contain one or more student exit points as defined by D.O.T. codes.

26. Program Objective - The outcome of a prescribed program of instruction. Usually expressed in terms of the occupation or job for which training is designed. D.O.T. codes are frequently used to identify program objectives or student exit points.

27. Self-Paced - Refers to a student moving through the prescribed training program at the fastest pace at which he/she can meaningfully learn.

28. Sequencing - Putting any set or series of learning activities or tasks into proper order or sequence. Normally arranged from simple to complex within groupings or blocks.

29. Software - Written or printed materials, slides, filmstrips, tapes, etc.

30. Student Manual - A document designed for use by students in a specific instructional program. It contains unit sheets, references, operational procedures, job sheets, etc.

31. Task - The smallest division of work in which a measurable output occurs. A logical and necessary step in the performance of a duty.

32. Task List - A listing of tasks performed by incumbent workers within a domain of interest. An example is a listing of all tasks performed by an automotive mechanic or by a worker in ornamental horticulture.

33. Unit - One "module" training material that generally covers one learning task and programmed on one unit sheet. May cover more than one lesson.

34. Unit Guide - A curriculum guide sheet that lists a task and objective with the instructional activities, instructional materials, evaluation and approximate time required for a student to successfully complete the task.

35. V'TECS Catalog - A comprehensive collection of performance objectives, performance guides, criterion-referenced measures and related data. Organized by a job structure or career ladder within a domain of interest.

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Title VI - Peyton Williams Jr., Associate Superintendent
of State Schools and Special Services
Title IX - Evelyn Rowe and Myra Tolbert, Coordinators
Section 504 - Jane Lee, Coordinator of Special Education

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